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Report of the Work of the Rubber Research Board in 1933.

(Established under Ceylon Ordinance No. 10 of 1930).

RUBBER RESEARCH SCHEME · CEYLON ·

March, 1934.

H. W. CAVE & CO., COLOMBO.

REPORT OF THE WORK OF THE RUBBER RESEARCH BOARD IN 1933.

(Established under Ceylon Ordinance No. 10 of 1930).

CHAIRMAN'S REPORT.

The Rubber Research Scheme (Ceylon) was established by Ordinance No. 10 of 1930 which came into force on August 1st of that year. The Board was appointed in November and held its first meeting in December 1930. The year under review therefore completes a period of 3 years under the present constitution of the Scheme.

Board Membership.—The three year period of office of the following nominated members of the Board terminated in November and the nominations were renewed for a further period of 3 years by those concerned :—

Mr. C. E. A. Dias, J.P.,
Mr. A. E. de Silva,
Mr. F. H. Griffith,
Colonel T. Y. Wright,
Mr. C. A. Pereira,
Mr. B. F. de Silva.

The following changes in the membership of the Board occurred during the year :—

Mr. F. H. Griffith returned from leave in January and resumed membership, relieving Col. G. B. Stevens who was acting for him.

Mr. James P. Fernando resigned on March 3 and was succeeded by Col. T. G. Jayewardene, V.D.

Colonel T. Y. Wright was on leave from March 22 to October 9, and Mr. E. L. Fraser was nominated to act for him.

Dr. W. Youngman was on leave from April 5 to August 6, and Dr. J. C. Hutson acted for him.

Mr. G. K. Stewart resigned on April 25 and was succeeded by Mr. L. P. Gapp.

The composition of the Board at the end of 1933 was as follows :—

Chairman, Director of Agriculture, Dr. W. Youngman.

Treasury Representative, Deputy Financial Secretary, Mr. C. W. Bickmore, C.C.S.

Unofficial Members of the State Council nominated by the Governor.

Mr. E. C. Villiers, M.S.C.,
Mr. H. R. Freeman, M.S.C.,
Mr. J. L. Kotalawala, M.S.C.

Members nominated by the Ceylon Estates Proprietary Association.

Colonel T. Y. Wright,
Mr. L. P. Gapp.

Members nominated by the Planters' Association of Ceylon.

Mr. F. H. Griffith,
Mr. B. M. Selwyn.

Members nominated by the Rubber Growers' Association.

Mr. I. L. Cameron,
Mr. E. W. Whitelaw.

Members nominated by the Low-Country Products Association.

Mr. F. A. Obeyesekere, M.S.C.,
Mr. C. E. A. Dias, J.P.,
Colonel T. G. Jayewardene, V.D., M.S.C.,
Mr. A. E. de Silva.

Members nominated by the Governor to represent Small-Holders.

Mr. C. A. Pereira,
Mr. B. F. de Silva.

Meetings.—Meetings of the Board were held on February 16, March 23, May 18, June 15, July 6, August 1, September 21 and November 23.

Meetings of Sub-Committee of the Board were held on February 28, March 23, June 24, July 8 and 27, August 24, October 23, November 6, and 27.

London Committee.—The Board contributed equally with the Rubber Research Institute of Malaya to the cost of research on the utilisation of rubber, carried out at the Imperial Institute, London, under the control of the London Advisory Committee for Rubber Research (Ceylon and Malaya), in accordance with the agreement referred to in the annual report for 1932. The London Advisory Committee held meetings on January 27, March 31, June 23 and October 27, and meetings of the Technical Sub-Committee were held on the same dates.

Development of the Research Scheme.—A meeting of the Board held early in the year confirmed the view that it was necessary to acquire a mature estate for experimental purposes. A Committee visited and reported on the suitability of a number of estates and negotiations were conducted in regard to several properties. After inviting offers of estates through the local Press the Board decided on August 1st to purchase Dartonfield

Estate, Agalawatte (173 acres) for a sum of Rs. 80,000/- plus transfer fees and other expenses of the Vendor Company. The estate was taken over from the date of the decision and the transfer was completed on November 8th. An Estate Committee consisting of Mr. F. H. Griffith (Chairman), Col. T. G. Jayewardene, Mr. J. L. Kotalawala and Mr. E. W. Whitelaw was appointed to advise on matters relating to the working of the estate. It was decided to appoint a full time estate Superintendent from the beginning of 1934. The vacancy was advertised and Mr. D. L. Nicol was selected for the post.

Application was made to Government for an area of 100 acres of forest land adjoining Nivitigalakele for experimental work in connection with clone testing and seed selection. The Hon'ble the Minister for Agriculture and Lands called for a detailed statement of the purposes for which the land was required and this was furnished towards the end of the year.

The Board decided at a meeting held in July to strengthen the chemical staff of the Scheme by the appointment of an assistant chemist for work on the utilisation of rubber. The post was advertised in the local and foreign Press and applications were received from all parts of the world. Mr. M. W. Philpott, B.Sc. (Lond.), was selected for the appointment and is expected to arrive in Ceylon in April 1934. Provision has been made in the 1934 estimates for the erection of an experimental factory and chemist's laboratory at Dartonfield, also for a Superintendent's bungalow and minor buildings.

A letter from the Hon'ble the Minister for Agriculture and Lands which was considered by the Board at a meeting held in November, expressed concern at the inadequacy of the results hitherto achieved by the Scheme in finding new uses for rubber. The Board agreed that there had been little progress in local work on the utilisation of rubber up to the present but considered that the steps taken during the year provided a sound foundation for advance in this direction and also for the investigation of agricultural problems. A report by the Director of Research on the work of the Research Scheme and the London Advisory Committee in promoting the utilisation of rubber, was submitted to the Hon'ble the Minister.

STAFF.

Director of Research and Chemist.—Mr. T. E. H. O'Brien continued his duties in the above capacities and also had charge of the administrative work of the Scheme under the general direction of the Board.

Mycologist.—Mr. R. K. S. Murray returned from home leave early in January and took charge of the Botanical work of the Scheme in addition to duties as Mycologist.

Agricultural Assistant.—Mr. W. I. Pieris continued his duties in this capacity.

Provident Fund.—The amended rules of the Fund were adopted by the Board early in the year. They have since been approved by the Governor in accordance with the requirements of the Rubber Research Ordinance and await the approval of the State Council. A statement of accounts for the year was supplied to each contributor to the fund, as required by the rules. The fund totalled Rs. 5,488 at the close of the year.

FINANCE.

The income of the Scheme for the year amounted to Rs. 186,652, this being mainly derived from a cess of $\frac{1}{8}$th cent. per lb. levied on exports of raw rubber. Income was considerably above the estimate and reflects the improvement in the condition of the industry as compared with the previous year. The monthly cess collections were as follows :—

January	...	..	Rs. 16,047·00
February	...	...	,, 14,379·00
March	...	...	,, 13,923·00
April	...	...	,, 12,851·00
May	...	...	,, 12,860·00
June	...	...	,, 14,514·00
July	...	...	,, 12,047·00
August	...	...	,, 16,260·00
September	...	...	,, 14,517·00
October	...	...	,, 16,069·00
November	...	...	,, 17,291·00
December	...	...	,, 16,003·00
		Total	Rs. 176,761·00

Current expenditure amounted to Rs. 80,914/- leaving a surplus for the year of Rs. 105,739/-. The purchase of Dartonfield Estate was, therefore, more than covered from current income. A profit of Rs. 1,716/- was derived from the working of the estate for the period August-December in spite of an unfavourable contract which was taken over under the terms of purchase.

A sum of Rs. 4,908/- was spent on the upkeep of the Experiment Station, Nivitigalakele and this, together with a sum of Rs. 984/- previously charged to land acquisition account and now transferred to Experiment Station, brings the development account up to Rs. 96,877/-. A small revenue was secured from the sale of the rubber derived from test tapping.

Certain modifications have been made in the form of the balance sheet. At the suggestion of the Auditor-General the value of buildings and other permanent assets has been restored to the level at which they were taken over from the old Research Scheme and the amounts allocated annually for depreciation have been transferred to a depreciation cash reserve account. The part of the surplus account represented by permanent assets has been transferred to an appropriate reserve account and the balance remaining under surplus account now represents the available cash surplus of the Scheme. The Balance Sheet at December 31, 1933, shows a cash surplus of Rs. 225,336/-.

The accounts of the Scheme have been examined by the Auditor-General and his certificate and report, together with the income and expenditure account and the balance sheet, are appended.

The reports of the Director of Research, Mycologist and Agricultural Assistant are also appended. The report of the London Advisory Committee for Rubber Research (Ceylon and Malaya) has not yet been received.*

W. YOUNGMAN,
Chairman,
Board of Management,
Rubber Research Scheme (Ceylon).

15th February, 1934.

* The report has since been received and adopted by the Board and is also appended.
20-6-34.

REPORT OF THE DIRECTOR OF RESEARCH FOR 1933.

Rererence was made in last year's report to the slow progress of research work owing to the depletion of the scientific staff. Mr. R. K. S. Murray returned from home leave at the beginning of 1933 and took charge of the botanical work of the Scheme in addition to mycological duties. Satisfactory progress has been made in investigations under these headings during the year and is discussed in detail in Mr. Murray's report. It was further pointed out that the depletion of staff was a reflection of the prevailing economic depression. The improvement in the position of the local rubber industry during 1933 has enabled the Board to make provision in the current estimates for the appointment of an Assistant Chemist for work on the utilisation of rubber and a secretarial officer who will relieve the writer of a number of administrative duties. Mr. M. W. Philpott, who has been appointed to the post of Chemist, is expected to arrive in Ceylon during April and the administrative post will be filled at an early date. It is hoped that these changes will lead to substantial progress being made in chemical research in 1934 and future years.

The progress of work during 1933 is considered below under appropriate headings.

DEVELOPMENT OF THE RESEARCH SCHEME.

Considerable progress was made during the year in developing the policy of the Research Scheme. The proposal to purchase a mature estate for experimental purposes involved the inspection of a number of properties by a Sub-Committee of the Board and resulted in a decision being reached on August 1st to purchase Dartonfield Estate, Agalawatte, about 12 miles from the Laboratories. There has been some criticism of the suitablity of the estate for experimental purposes on the grounds that the agricultural condition is above the average and that the results of field experiments will not be applicable to estates in poor agricultural conditions. It has however, to be kept clearly in mind that the results of trials carried out on any one type of land will be indicative rather than absolute. The results will be in the nature of reliable comparisons between treatments, which will have to be considered by Estate Proprietors in relation to their own requirements. There can be no doubt that reliable field trials at Dartonfield will give results of great value to the industry and the foresight of the Board in accepting the offer of an estate which fulfils these conditions rather than continuing to search for the ideal, is brought into prominence by the steady rise in the value of Rubber properties in recent months.

The purchase of the estate may be regarded as providing the necessary foundation for the steady development of the Scheme both in respect of agricultural and chemical research. A programme of field experiments at Dartonfield dealing with tapping, replanting, manuring of mature and replanted areas, prevention of soil erosion, etc. has been approved by the Estate Committee and recommended to the Board for adoption. A replanting experiment on an area of 7 acres, for comparison of methods of removal of timber and control of cover crops, has been arranged for 1934 and the preliminary operations were undertaken during November and December. The material used in replanting experiments will consist of promising local and foreign clones but it has been decided to continue the preliminary testing of local clones on virgin land. Application was made to Government for an area of 100 acres of Crown land adjoining Nivitigalakele for the extension of this work and for experiments in generative selection and the matter is at present under consideration. Budwood from over 100 promising local mother trees is available for planting in the field as soon as land is allocated.

Provision for the extension of chemical work has been referred to in a previous paragraph. The lines of work which it is proposed to follow relate to (a) improvement of the properties of raw rubber to meet the requirements of manufacturers (b) investigation of such new uses of rubber as can suitably be dealt with in Ceylon (c) demonstration of the possibilities of local manufacture of certain types of vulcanized products. Facilities for this type of work will be provided in an experimental factory which is to be erected at Dartonfield and a laboratory for the Assistant Chemist will also be built on the estate.

CHEMICAL SUBJECTS.

Crumb Rubber.—Details were published in a recent issue of the Rubber Research Scheme *Quarterly Circular* of the methods for preparing crumb rubber which were developed by the London Advisory Committee and patented in conjunction with the Rubber Growers' Association. Further investigation was carried out locally in regard to the best conditions for preparing nitrite crumb with specific properties and a 2 cwt. sample was prepared in small batches at the laboratories and forwarded to London for trials in connection with a process which has since been made the subject of a further patent.

A disintegrator for the preparation of crumb rubber by the mechanical treatment of crepe, was installed in a neighbouring factory and preliminary trials have shown that no serious difficulty is likely to arise in preparing the material from freshly milled wet crepe. This product is of interest in connection with the Ungar-Schidrowitz process for softening rubber,

which consists of a specified heat treatment of raw rubber, which has previously been broken down into the form of crumb. In the event of the manufacture of vulcanized products being developed in Ceylon it seems possible that crumb rubber softened by the Schidrowitz or other method will form a convenient raw material, in order to eliminate the expensive masticating machinery which would otherwise be required.

Hot Water Treatment of Coagulum.—In continuation of the investigations referred to in last year's report a sample consignment of 5 chests of crepe prepared from coagulum which had been soaked in boiling water was forwarded to London and distributed for Manufacturers' trials. Reports on the material indicate that the improvement in plasticity is not sufficiently marked for the product to be of special interest to Manufacturers in view of the development of other methods of treatment, which have a much greater softening effect on raw rubber.

Crepe Rubber.—A number of estates have again found difficulty in producing crepe rubber equal in appearance to the standard required on the Colombo market. The premium of crepe over sheet was maintained during the year and this, as explained last year, has led to drying accommodation in crepe factories being overtaxed and resulted in the crepe developing mould during drying. The trouble was again accentuated by prolonged wet weather in the latter part of the year. In certain cases blanket crepe which left the factory in good condition was reported to be off colour or streaky after a short period of storage. Discoloration of crepe during storage is usually attributed to oxidation but the fact that crepe which has been disinfected by treatment of the latex by chemical means or by boiling the coagulum, maintains its colour satisfactorily, suggests that discoloration is frequently due to the action of fungal organisms. The following trial was carried out on behalf of an estate on which considerable trouble with rapid discoloration of crepe rubber has been experienced. Half of a day's crop of crepe was dried in the warm air chamber at the laboratories while the remainder was air-dried at the estate factory during showery weather. Both batches of rubber were blanketed, graded and stored for a month. At the end of the period 35 per cent. of the air-dried crepe had become streaky or discoloured whereas the crepe dried in warm air was in good condition. It is considered that the air-dried crepe had become infected in the drying loft and that gradual development of the organisms occurred during storage.

Discoloration of crepe rubber is frequently attributed to the adoption of double cut tapping systems and a number of observations were made on this point. Comparative samples were prepared at intervals during the year from adjacent plots near the laboratories, tapped respectively on the

"alternate daily" and "double four" systems. Crepe from the double-four plot was distinctly yellower than that from the alternate-daily plot but there was no tendency for it to be "off colour" *i.e.*, to have a brownish tinge. Even after a ten-day tapping interval during wet weather the crepe was considered to be up to market standard. It appears to be largely a question of taste on the part of the buyers whether the yellower colour of crepe from double cut tapping is regarded as a drawback. The somewhat richer latex from double cut systems may lead to an increased tendency to discoloration of crepe but generally speaking there is no reason to suppose that the systems lead to difficulty in crepe manufacture.

The Use of Paranitrophenol in Crepe Manufacture. —Several years ago it was shown that the development of mould in crepe could be prevented by the addition of a small proportion of P. N. P. to the latex (1 :4000) at the time of coagulation. Vulcanization trials showed that the quality of the rubber was not affected by the proportion of P. N. P. used. The treatment was recommended as a means of preventing mould and was adopted on a few estates, where it proved very satisfactory. Manufacturers have recently objected to the presence of P. N. P. in crepe rubber on the grounds that it is liable to cause staining of certain light coloured goods and the wrapping papers used for packing. A commercial sample of crepe containing P.N.P. was recently forwarded for trial and tests by two Manufacturers have confirmed that staining of wrappings is liable to occur.

Although a relatively small proportion of the total output of crepe rubber is used for purposes in which this difficulty is likely to be of importance, it is necessary for Producers to meet the wishes of Consumers in every way possible and the Research Scheme cannot recommend the further use of P. N. P. in crepe manufacture. It is unfortunate that this decision is necessary as P. N. P. is the only chemical tested up to the present, which is suitable in other ways for preventing the occurrence of mould in crepe drying rooms.

It should be made quite clear that no objection has been raised to the use of P. N. P. as a mould preventive in the preparation of smoked sheet; in fact its moderate use for this purpose has been endorsed by manufacturing interests.

Rubber Distillate.—Two samples of "extract of scrap rubber" were received from an estate with a request for the materials to be tested, as an ingredient for paint mixing and as a wood preservative respectively. The samples appeared to consist of crude rubber distillate, one being more viscous than the other and perhaps being mixed with a proportion of melted rubber. The cost was stated to be 20 cents and 10 cents respectively per bottle. The price of raw rubber was then about 10 cents per lb.

A series of paint mixings was prepared using (a) linseed oil and turpentine (b) linseed oil and rubber oil (c) rubber oil and turpentine (d) rubber oil only; in conjunction with Swedish red oxide. The paints were applied to an iron roof and examined after 4 months. The samples prepared without linseed oil were free from discoloration by mould and were therefore more attractive than the others. It was concluded that a mixture of pigment and rubber oil would form a useful paint, reasonably resistant to tropical weather conditions but that its use would not be profitable at the present price of rubber.

A sample of the other grade of oil was forwarded to the Government Entomologist who tested its properties of resistance to termite attack by keeping two pieces of wood treated with the mixture in a nest of *Cyclotermes redemanni*. On examination after 5 months one specimen had been attacked and partially destroyed while the other remained undamaged. A similar test is in progress at the laboratories but results are not yet available. The result reported by the Entomologist indicates that the material is not fully effective as a wood preservative. This is probably because it does not soak into the wood but remains as a varnish on the surface.

Reference was made in last year's report to local trials of melted rubber as a paint, which gave relatively unsatisfactory results. Recent research by the Rubber Growers' Association on the incorporation of rubber in paints has led to the use of certain oxidation catalysts which have the effect of reducing the viscosity of rubber solutions and are reported to have a similar effect in reducing the viscosity of melted rubber. There is therefore scope for further investigation of the possibilities of modified melted rubber as a paint for local use. A sample of one of the catalysts has been received and trials will be made shortly.

Vulcanized Crepe.—In continuation of the preliminary experiments reported last year a full investigation was made of the conditions under which self-vulcanizing crepe can be prepared by the addition of compounding ingredients to latex before coagulation. The method used for judging the extent of vulcanization was to observe the effect of benzene on the rubber. Raw rubber dissolves in benzene and other hydro-carbon solvents whereas vulcanized rubber swells without dissolving, the extent of swelling depending on the degree of vulcanization and decreasing as vulcanization proceeds. The samples were tested by measuring the extent of swelling during 24 hours' immersion in benzene.

It was found from a series of trials that crepe rubber prepared from compounded latex under suitable conditions vulcanizes slowly at ordinary temperature and is sufficiently cured after about 20 days to be resistant to sunlight and insoluble in raw rubber solvents. The rate and extent of vulcanization depend largely on conditions of preparation, the most

important factors being (a) vulcanization is more satisfactory if alum is used as coagulant in place of acetic or formic acid (b) addition of sodium bisulphite to the latex increases the rate of vulcanization. Satisfactory vulcanized crepe was prepared from a mixing containing 3 parts zinc oxide, 1·5 parts sulphur, 0·75 parts Z.D.C. accelerator and 0·5 parts sodium bisulphite per 100 parts of rubber in the form of 30 per cent latex; coagulated by addition of 3·3 parts of alum in the form of 10 per cent solution. A report on the experiments was published in Rubber Research Scheme *Fourth Quarterly Circular* for 1933.

Considerable interest was taken in the trials by Estate Superintendents and 10 samples of the vulcanizing mixture were supplied to estates for experimental purposes. It is understood that several estates are considering experimental manufacture of the material for use as bath and table mats.

Impregnation of Hessian with Latex.—An enquiry was received from a Calcutta firm regarding the treatment of hessian with latex to anchor the fibres and provide a more suitable material for use as wool packs. A number of trials were made, the most promising method of treatment tried being to spray the hessian with latex which had previously been vulcanized by heating in presence of S.D.C. accelerator and other requisite ingredients. Further trials are necessary to determine whether the treatment could be applied on a large scale and at an economic price.

A local Estate Superintendent has developed a method of coating hessian with compounded latex to provide an attractive waterproof material, which is being marketed under the name of "Rubaulins". The Research Scheme has assisted in the development of the product by providing information in regard to vulcanizing materials, etc. There should be a wide outlet for this and other rubberized fabrics in eastern countries if satisfactory ageing properties can be assured and it appears to be a type of manufacture which is well suited to local conditions.

MYCOLOGICAL AND BOTANICAL SUBJECTS.

Mr. R. K. S. Murray took charge of the botanical work of the Scheme on his return from home leave and the part of his report dealing with this branch suitably opens with a discussion of the lines of agricultural research which are being followed. In developing the policy of a small Research Institute it is very necessary to ensure that attention is concentrated as far as possible on subjects which are of special local interest and this principle is being kept in view in regard to all branches of the work of the Research Scheme.

Oidium Leaf Disease.—There are indications of an extension of the areas severely affected by Oidium leaf disease in districts at medium elevations and the Mycologist points out that the possibility of the fungus

becoming gradually acclimatised to the warm moist conditions of lower elevations should not be ignored. This possibility adds to the importance to the sulphur dusting experiments which are being undertaken by the Research Scheme at Kandanuwara Estate, Matale. Unfortunately control of the disease during this year's operations was again unsatisfactory, this being attributed to unsuitability of the grade of sulphur which was being tested.

The steady fall in the yield of the undusted field to 200 lbs. per acre and the reduction of rubber content of the latex to less than 3 lbs. per gallon is a striking demonstration of the damage caused by *Oidium* under certain climatic conditions and indicates the necessity of control measures being undertaken if rubber is to be maintained as an economic crop in areas subject to severe attack.

Fomes Lignosus.—An investigation was made of the circumstances of an outbreak of *Fomes lignosus* root disease in a recently replanted area and the Mycologist draws attention in his report to the indications that this fungus may lie dormant in the soil for a long period and become reinvigorated when the soil is disturbed during replanting operations. This factor will require careful consideration in relation to the removal of timber and roots when replanting rubber areas.

Sun-scorch of Budgrafts.—Further observations on the effect of sun-scorch in damaging the callus bark near the point of union of young buddings were made at Nivitigalakele where a number of cases occurred during the dry season. Similar damage was reported from estates. Under average local conditions serious injury from this cause appears to be mainly associated with buddings on large stocks and difficulty is less likely to arise in this direction in the case of buddings on young stocks.

Mother Trees, Test-Tapping, Etc.—A number of estates continued to provide records of the yields of prospective mother trees but there has been a big decline in the number of such trees under observation in the last few years. As mentioned in an earlier paragraph budwood from over 100 promising trees is awaiting field test by the Research Scheme when land is available. Apart from testing this material, space will be reserved for testing any trees of outstanding promise which are brought to our notice in the future and particulars of such trees will always be welcomed.

The number of Ceylon clones under test-tapping increased considerably during the year under review. Representatives of 33 local clones are being tapped at Nivitigalakele and further clones on a number of estates are also being tapped in collaboration with the Research Scheme. It is considered that such collaboration is of mutual benefit to the industry and to the individual estate concerned. The results of test-tapping in 1932 were published during the year and these reports will be an annual feature.

Close touch was kept with records of the test-tapping of foreign clones and a resumé of yields for 1932 was published for the information of local producers. Buddings from a number of the well-known imported clones are now reaching tappable size in Ceylon and yield records will be awaited with interest.

Further cross-pollinations of budded trees were made at Nivitigalakele during the flowering season and a few pedigree seedlings were successfully established. The trees are not yet sufficiently mature to flower freely and a disproportionate number of seeds dropped before maturing or failed to germinate.

Tapping.—Double-cut tapping systems in different forms were widely adopted on estates in the main rubber growing districts and their popularity has been consolidated in the light of further experience of their use. The Research Scheme has been able to advance from the position of cautious approval of the systems as a means of reducing tapping costs and the opinion is now expressed that double-cut systems, in the form best suited to the individual estate, may largely supercede the alternate day system in most districts. A final opinion on the systems will depend very largely on the question of satisfactory bark renewal. Measurements made up to the present do not suggest any inferiority in this respect as compared with the alternate day system. The adoption of double-cut systems is probably easier in Ceylon than other producing countries owing to the annual or six monthly change of tapping panel which has been customary in the past, resulting in mature bark being available on both sides of the tree.

Tapping experiments to compare the "double-three A.B.C." system with normal alternate day tapping, which were laid out in consultation with the Research Scheme, are in progress on two estates and the results available to date are discussed in the Mycologist's report. Yield figures of an estate experiment comparing "double-four" and alternate day tapping are also being made available to the Scheme. A small experiment on 3 plots near the laboratories comparing the same systems, has given results which have a certain value, especially in confirming the rise in rubber content of the latex under the double-four system.

EXPERIMENT STATION, NIVITIGALAKELE.

Budding of the clearings was virtually completed in 1932 and the only work required in this direction has been to replace a certain number of casualties with budded supplies. The rate of growth of the trees is satisfactory in most areas. No artificial manures were applied to the clearings during the year, but green manures were forked into the platforms throughout the Station. Severe winds during May caused considerable damage especially in the 1926 clearing. A careful analysis of the extent and type of damage to different clones was made by the Agricultural Assistant.

Approximately 400 trees were being test-tapped at the end of the year. The principle adopted is to bring 12 trees of each clone into tapping as they reach a girth of 16 inches to provide a preliminary indication of the prospects of the clone. Other trees of the clone, tapped on reaching a girth suitable for commercial tapping, will provide the main yield records.

Further observations were made on the effect of various treatments of the cut surface of stocks in preventing and arresting decay, the results of inspection of a number of experimental trees by the Agricultural Assistant being embodied in a report which will be published shortly. The subject is of importance at the present time owing to the amount of budding which has been done at Nivitigalakele and elsewhere on comparatively large stocks but little difficulty should arise in the future when budding is carried out on one to two year old seedlings.

The seedling nursery laid down last year to provide budded stumps for distribution to peasant cultivators developed well and these plants will be budded during 1934. Budwood of a number of imported clones was multiplied to provide material for this purpose and for experimental use at Dartonfield. The successful trials of transplanting stumped buddings, reported by the Mycologist, are of interest as the issue of budded plants to small-holders in this form would reduce the likelihood of a stock shoot being allowed to grow by mistake and there would be less chance of damage to the young budshoot. This method will be adopted if further trials give satisfactory results.

Dartonfield Estate.—The estate was taken over by the Research Scheme from August 1st. Messrs. Lee, Hedges & Co., Ltd. continued to manage the property until the end of the year and Mr. J. F. Templer, who had been part-time Superintendent for a number of years, remained in charge until the full-time Superintendent was appointed in January. The opportunity is taken to thank Mr. Templer and the Agency Firm for their very helpful co-operation during this period. As the estate was formerly worked in conjunction with the adjoining estate, Gallawatte, there are no buildings except Conductor's bungalow, lines and coagulating shed. The rubber is made up into crepe at Gallawatte factory.

Generally speaking the estate comprises a long hillside facing west, broken up by various folds and undulations. Gradients and general conditions are approximately typical of local hillside estates. The trees in most areas are well grown and soil erosion has been minimised by careful attention to draining and terracing. The estate comprises 3 main clearings planted in 1910 (32 acres), 1913 (62 acres) and 1917 (57 acres). During the year previous to purchase, half the area was rested and the remainder was tapped on the "double 3 A.B.C." system. The rested area was brought into

"double-three" tapping at the beginning of August to meet a forward contract in the latter part of the year. As from December 1st the whole estate was put on to "double-four" tapping to ensure that all trees should receive equivalent treatment for some months before experimental areas are laid out.

A nursery of 10,000 seed was laid down in a deniya area during September to meet future replanting requirements. It was decided to replant an isolated field of 7 acres during 1934 and lining and holing was carried out during December.

Crop for the period August-December amounted to 45,178 lbs. and was produced at a cost of 10·92 cents per lb. Forward contracts totalling 16 tons at 15 cents per lb. were taken over and duly fulfilled. A further contract for 12 tons at 15½ cents for delivery January-June 1934, was liquidated by a cash settlement.

ADVISORY WORK, CORRESPONDENCE, ETC.

The advisory work of the Scheme in dealing with enquiries from estates, continues to be an important feature and it is encouraging to note that Ceylonese Proprietors are making increasing use of the services of the Research Scheme in this direction. A material proportion of the technical staff's time is occupied in dealing with advisory correspondence but it provides a very useful means of keeping in close touch with the requirements and views of the industry.

Agricultural enquiries during the year were largely concerned with tapping systems, cover crops under old rubber and matters relating to budding. On the chemical side interest was mainly shown in defects of crepe rubber, smokehouse design, the possibilities of vulcanized crepe and other new uses for rubber. Reports were furnished to the Director of Commercial Intelligence on various matters relating to the rubber industry, which had been referred to him for investigation.

Correspondence of the Scheme during 1933 was as follows :—

	Inward		Outward
Secretarial Office (not including printed matter and circulation papers).	805	...	1,140
Laboratories :—			
Estates and Agencies	883	...	948
General	643	...	552
Chairman and London Committee	133	...	97
Total	2,464	...	2,737

The following visits were made to estates by Technical Officers :—

	Director	Mycologist	Agricultural Assistant
Advisory—Agricultural	—	21	—
Advisory—Manufacture	11	—	—
Experimental	3	18	11
Miscellaneous	—	6	2
Total	14	45	13

The Director of Research was present at Board meetings by invitation and also attended the Annual General Meeting of the Planters' Association of Ceylon. The technical officers attended the official opening of the Coconut Research Scheme Laboratories and one or more members of the staff were present at general meetings of the Kalutara Planters' Association.

Co-operation with other Research Organisations.—Close co-operation was maintained with the Rubber Research Institute of Malaya both by personal correspondence and by exchange of progress and other reports. Reports of the proceedings of the Technical Research and Development of New Uses Committee of the Rubber Growers' Association were regularly received and additional copies were provided for the information of members of the Board. Publications are exchanged with a number of other research organisations. The writer has the privilege of being an Honorary Technical Advisor to the Institution of the Rubber Industry for the Session 1933-1934

VISITS TO THE LABORATORIES.

Visits to the laboratories were made by Dr. J. C. Hutson, acting Chairman of the Board; Dr. P. S. Hudson, Deputy Director of the Imperial Bureau of Plant Genetics; Dr. J. C. Haigh, Economic Botanist, Ceylon; Dr. R. Child, Chief Technical Officer, Coconut Research Scheme, Dr. P. J. S. Cramer and a number of estate Proprietors, Superintendents and Assistants.

A visit was made to Colombo to meet Mr. F. D. Ascoli, Managing Director of Dunlop Plantations, Ltd.

PUBLICATIONS.

Publications of the Research Scheme are issued without charge to Proprietors (resident in Ceylon), Superintendents and local Agents of rubber estates in Ceylon who apply for their names to be registered for the purpose. Registration is renewable annually. In spite of a reminder to this effect being enclosed in the last publication of each year the number of applications for registration fell from 280 in 1932 to 168 in 1933. Early this year (1934)

a letter was addressed to Colombo Agency firms, the Secretary of the Planters' Association of Ceylon and the Honorary Secretary of the Low-Country Products Association inviting their co-operation in reminding estates of the conditions under which the publications are available. At the time of writing, estate registrations for 1934 total 274, which must be regarded as an unsatisfactory figure, considering that 390 estates subscribed to the funds of the Research Scheme before the present constitution came into force. Attention is drawn to the matter because the value of a research organisation depends very largely on the extent to which the results of investigations are brought to the notice of those concerned.

Publications during 1933 comprised the Annual Report and Accounts for 1932 and four issues of the *Quarterly Circular*, the contents of the latter being :—

1st Quarterly Circular.

Further Yield Records in connection with *Oidium Heveae*. By R. K. S. Murray.

Diseases of Rubber in Ceylon, 1932. By R. K. S. Murray.

The Effect of Earth-Cowdung Mixtures on Renewing Bark. By R. K. S. Murray and W. I. Pieris.

2nd Quarterly Circular.

Ceylon Clones I. By R. K. S. Murray.

A Note on Sun-Scorch of Budgrafts. By R. K. S. Murray.

The Use of Reclaim in Rubber Manufacture. By G. Martin.

3rd Quarterly Circular.

"Double-cut" Tapping Systems in Ceylon. By R. K. S. Murray.

Proved Hevea Clones II : Clones in Malaya and the Dutch East Indies. By R. K. S. Murray.

"What Are Our Latest Views Regarding Buddings as Planting Material?" By Ir. J. S. Vollema (translation).

4th Quarterly Circular.

Notes on Low Temperature Vulcanisation. By T. E. H. O'Brien.

Report on Softened Rubber. By G. Martin, W. S. Davey and H. C. Baker.

The Preparation of Soft Rubber by means of sodium nitrite. By G. Martin.

Methods of Preparing Raw Rubber in Crumb or Powder Form. By G Martin.

Rubber Roadways (reprint).

SUMMARY OF WEATHER RECORDS AT THE LABORATORIES.

	1933.	1932.
Rainfall	147·93 in.	148·41 in.
Highest monthly rainfall	31·285 in. (May)	26·96 in. (Aug.)
Highest daily rainfall	4·305 in. (May 15)	5·35 in. (Aug. 25).
Highest shade temperature recorded (day).	93·7°F (Mar. 15)	95·0°F (Jan. 26).
Lowest shade temperature recorded (day).	74·2°F (Dec. 21)	72·9°F (Aug. 26).
Lowest shade temperature recorded (night).	66·5°F (Nov. 19)	65·2°F (Feb. 5).

T. E. H. O'BRIEN,
Director of Research,
Rubber Research Scheme (Ceylon).

Rubber Research Scheme Laboratories,
Culloden,
Neboda, 21st February, 1934.

MYCOLOGIST'S REPORT FOR 1933.

On return from furlough in January the writer assumed charge of botanical as well as mycological duties, and the progress of investigations during the year is summarised under these two main headings. Owing to the greater immediate importance of research along botanical and general agricultural lines, the pathological work has been almost confined to advisory service and minor investigations arising therefrom.

I. MYCOLOGICAL WORK.

Oidium Leaf Disease.—Observations made during 1933 indicate an extension of the most severely affected areas at mid-country elevations. Estates in the Matale valley, for example, which in former years experienced only the mildest form of attack, were subjected in 1933 to somewhat severe defoliation, while the period during which the fungus was active was considerably extended. The danger that the fungus, by a process of gradual acclimatisation, may become increasingly destructive in the hot, moist zones is not to be ignored, and this increase in severity, coupled with the brighter market prospects, lends added importance to the experiments on control measures.

A further series of sulphur dusting operations was undertaken on Kandanuwara Estate, Matale, during the months January to March. The same experimental field of 30 acres was dusted, this being the fourth successive year of treatment. The main object of this year's experiments was to determine the value of a fungicidal dust known as "Chemical Sulphur R.V.3". This product is a mixture based on pure sulphur and various sulphur compounds, and contains a relatively high proportion of inert matter. Preliminary small scale tests showed that it exhibited some degree of toxicity to the fungus and that its physical properties were good, and its cheapness as compared with pure dusting sulphur appeared to justify a field trial. Six applications were made at the rate of 13-15 lbs. per acre at intervals of 9-13 days, but the results as compared with an adjacent untreated field were negligible, the foliage in the dusted field being little, if at all, superior to that in the control. Since conditions were otherwise favourable for the operations it must be concluded that "Chemical Sulphur R.V.3", as used in this test, is of no value in the control of the disease.

Throughout the 1933 work a machine known as the "Nabo" Motor Powder Spray Outfit, purchased on trial from Messrs. Cooper, Pegler & Co., Ltd., was used. Apart from various minor details, modifications for which were suggested in a report to the manufacturers, the machine gave satisfaction.

The recording of yields from plots in the dusted and control fields was continued throughout the year, all the latex rubber being sent to the laboratories to be weighed as from the 1st April. The results have not been fully calculated at the time of writing, but the main points may be noted. The outstanding feature of the year's records is a substantial decline in the yield from both areas. The yield of the control field, which has been tapped continuously throughout several years of constant severe defoliation, has now fallen to about 200 ibs. per acre, while the rubber content of the latex during 1933, as determined by trial coagulations, varied from $2\frac{1}{4}$ to 3 lbs. per gallon. The yield of the dusted field stands at about 300 lbs. per acre, with a rubber content of 3-$3\frac{1}{4}$ lbs. per gallon, and its superiority must be attributed to the cumulative benefit of the successful control measures in 1930 and 1931. The marked response in yield to the retention of the new foliage after wintering, which was such a striking feature after the successful dusting in 1931, was entirely absent in 1933 when control was negligible. The experimental field has now been two years without satisfactory control, (on account of a mechanical breakdown in 1932 and due to the ineffectiveness of the fungicide in 1933) and it is to be hoped that the success of the dusting operations planned for 1934 will not be upset by any untoward circumstances.

Fomes Lignosus.—An investigation carried out in connection with outbreaks of *Fomes lignosus* root disease on young stumps in a replanted area appears to indicate that this fungus may lie dormant in the soil for many years, being capable of re-invigoration to active parasitism by the cultural operations associated with replanting. This "staling" and subsequent rejuvenation is a common phenomenon with fungal cultures, and if confirmed by further field observations may have an important bearing on replanting procedure. In the past the general (though condemned) practice for preventing the spread of infected areas has been to rely entirely on isolation trenches, the diseased roots being left in the soil. If, after some years, no fresh cases have occurred in the vicinity of these areas, it is assumed that the fungus has died out. This is often correct, but it would now appear that such areas cannot be safely replanted until all old roots remaining within, and possibly for a short distance outside, the isolation trench have been removed and burned. The question of root removal prior to replanting is receiving attention in an experiment at Dartonfield Estate.

Sun-scorch of Budgrafts.—In the Mycologist's Report for 1932 mention was made of a dieback of the callus bark near the union of young

buddings, the primary cause being sun-scorch. This condition was further studied at Nivitigalakele during the hot weather in March, a considerable number of buddings two to four years of age being thus affected. The raised bark growing over the cut end of the stock becomes irregularly cracked, and the bark usually dies back to the wood. In most cases recovery is rapid, but if *Botryodiplodia theobromae* gains entrance the damage is extended into the wood and up the scion, and the plant may have to be removed. On the Station the injury appeared to be accentuated by the presence of a plastic mixture of Colas and sand used to fill cavities caused by the decay of the stock snag, and it is probable that any black dressing of the snag will tend to have this effect.

This form of injury is clearly liable to occur during any prolonged spell of hot dry weather, particularly where large stocks have been used. It is best guarded against by growing a living shade of erect green manure plants close to, and on the south side of, the budgrafts. These may have to be tied to the stem so as to provide an effective shade, or loppings can be heaped over the union. One estate in a dry district has earthed up the union, but this procedure introduces the danger of termite attack. The damage has only been observed where the callus bark is exposed to the hot mid-day and afternoon sun, and can therefore be obviated by orientating the bud so that the bark receives the partial shade of the stem during the hottest part of the day.

II. BOTANICAL WORK.

The botanical work of the Scheme embraces investigations which in a larger institute would be dealt with by a number of departments—genetical, physiological, agricultural and soils. The demands of advisory service alone necessitate due attention being given to all these lines of work, and with the limited personnel available it is therefore impossible to record rapid progress in any one direction. In arranging a programme of research it has been the aim to concentrate on problems which are of special importance to Ceylon growers, at the same time keeping in the closest touch with more fundamental investigations being conducted by larger institutes. In this way the Scheme can act as an advisory centre for information which is applicable to all rubber producing countries, while remaining free to pursue enquiries along special lines.

Broadly, any programme of botanical research may be considered under two headings :—

1. The improvement of planting material,
2. Problems connected with mature Rubber.

Replanting of old areas with high yielding material forms a link between the two.

The improvement of planting material involves a study of variation, the selected individuals being propagated either vegetatively or generatively. Vegetative propagation of Hevea is almost exclusively carried out by budgrafting, and work on these lines entails the selection of promising mother-trees, the testing of their vegetative progeny (clones), and the study of all matters connected with the technique of budgrafting and subsequent care of the grafts. Improvement by means of generative propagation involves breeding by artificial or controlled fertilisation, and this genetical work, though very slow in showing tangible results, will probably be productive of the greatest ultimate improvement. Work on vegetative propagation has been pursued for some years at Nivitigalakele and in co-operation with estates, and breeding has been started on a small scale. It is hoped that the acquisition of further forest land in the near future will afford the opportunity of extending this work.

During recent years the bulk of botanical research in all rubber producing countries has been directed towards the development of high yielding material, and the problems concerned with tapping, cultivation and upkeep of mature areas have not, perhaps, received their fair share of attention. In Ceylon it has been difficult in the past to conduct satisfactory experiments along these lines owing to the fact that the Scheme has not controlled its own mature Rubber. With the purchase of Dartonfield Estate, however, this disability no longer exists, and a comprehensive programme of field experiments has been drawn up and recommended to the Board by the Estate Committee.

Field Experiments at Dartonfield.—This programme provides for investigations on tapping systems, artificial and green manuring, prevention of soil erosion, replanting, test of clones on replanted land, cultivation of budgrafts on replanted land, etc. A great deal of time and attention has been devoted to the design of these experiments in order that they should satisfy the requirements of subsequent statistical analysis, and at the same time be practicably workable. The valuable advice on experimental layout given by Mr. T. Eden of the Tea Research Institute is hereby gratefully acknowledged. One replanting experiment, involving several series of comparisons, was commenced in November, and it is hoped that tapping and manuring experiments will be put in hand during the course of 1934.

The Improvement of Planting Material.

A. Budgrafting.

1. *Selection of Mother Trees.*

Yield records continue to be received from high-yielding estate trees from which budwood has or may be taken to establish clones. The number of such mother trees from which records were received in 1933 shows a considerable decline as compared with previous years, the figures being:

	Estates	Trees
1933 ...	18 ...	107
1932 ...	27 ...	190
1931 ...	39 ...	524

No special effort is being made to persuade further estates to keep records, (except when particularly promising trees are brought to our notice) on account of the large amount of material which already awaits attention. The budwood multiplication nursery at Nivitigalakele now contains budwood of 184 clones which have not been established in the field; of these more than 100 are considered to be of outstanding promise on the basis of the mother tree records. Further forest land is urgently needed for the testing of these clones and of further promising material which will come to light in the future.

2. *Budding, Planting and Attention.*

(a) *Technique of Budding Operation.*—Although budgrafting is a process which has long since passed from the domain of special technical work into the realm of normal estate procedure, it seemed that one or two minor points regarding the choice of buds needed investigation. A small-scale experiment was accordingly carried out at Nivitigalakele, the general results of which are given in the Agricultural Assistant's Report. It is concluded:—

1. That rather greater success is obtained with scale leaf buds than with those in the axil of developed leaves; there appears to be no difference in the time taken for these two types of buds to break, though observations on the vigour of the shoots remain to be made.
2. That even badly damaged buds may "take" and grow, though the chance of success with even the slightest injury is seriously reduced.
3. That scraping the bark of the bud patch a short distance above the successful dormant bud does not materially expedite its shooting. Further tests are needed to determine whether any form of local injury will force obstinate buds to shoot quickly.

(b) *Transplanting "stumped" buddings.*—A number of supplies at Nivitigalakele were put out in the form of "stumped" bud-shoots; *i.e.*, the bud was allowed to grow in the nursery and the shoot cut back before transplanting. The method promising greatest success is to cut back a well grown shoot (about a year old) in brown wood at a height of about 12 inches above the union, wait until the uppermost buds are just breaking, and then transplant into large holes. Supplies put out in November in this form have survived a dry spell of weather in December. The method should be of special value in supplying vacancies in established budded areas, and if the stock has been finally cut back some months prior to transplanting there is the additional advantage that the snag will have largely or completely healed over before being exposed to the less favourable conditions in the field. The object of stumping at a low level is to ensure that any subsequent crookedness of the trunk occurs below the greater part of the tapping surface. Tests are also to be made with high stumping of older bud-shoots, the cut in this case being made above the future tapping surface.

(c) *After-treatment of Stocks.*—The Agricultural Assistant has made a detailed investigation of methods of treating the stock of field buddings, the results referring in particular to large stocks. The outstanding conclusions are:—

1. That the snag should not be left to decay and fall off; it should be cut back to the level of live wood at an angle of at least 45°.

2. That Skene's pruning mixture is a cheap and suitable protective covering for the cut end, and that the covering should be renewed every six months until the union has healed over.

3. That it is of the first importance to ensure rapid callusing by maintaining the plant in a state of vigorous growth. If this is done there is unlikely to be trouble with the decay of the snag even if no protective covering is provided.

4. That if the snag has decayed with the formation of a hollow the rot can be checked by cutting out all diseased wood, disinfecting, and filling with either cement and sand, or preferably with a plastic mixture such as Colas and coir-dust.

These conclusions confirm in all respects the general field observations made at Nivitigalakele and elsewhere, and have formed the basis for recommendations to estates.

3. *Vegetative Propagation of Stocks.*

The Agricultural Assistant reports a small measure of progress in raising uniform stocks by the process of "layering", the proportion of successfully rooted stems amounting to about 20%. These results encourage the belief that with improved methods it may be possible to raise sufficient uniform stocks to be of value in investigations on the inter-relationship of stock and scion.

4. *Studies on Clones.*

(a) *Ceylon Clones.*—The number of Ceylon clones in regular test-tapping has been considerably extended during the year. At Nivitigalakele 33 Ceylon and 2 imported clones, represented altogether by 283 trees, are now being regularly tapped, and further clones will come into tapping during the course of 1934. The policy at present being adopted for these early records is to bring trees into tapping, up to 12 of each clone, as soon as their girth exceeds 16 inches. More permanent records of greater value will be derived from further groups of trees opened when they are of a suitable size for commercial tapping. Several of the older clones are now ready to be tapped in this way, and cuts will be opened after the wintering period.

Test-tapping of Ceylon clones has also been carried out on a number of estates in collaboration with the Scheme. In most cases the individual biscuits are sent every month to be weighed at the laboratories, the records being entered up in special forms. At the end of the year these records were being received from 37 clones on 4 estates. Observations on these clones and advice regarding test-tapping methods necessitated several visits to the estates concerned.

At the time of writing this report the full records for 1933 are not available. All data regarding the more promising clones will be published early in 1934 as the second of a series of reports on Ceylon clones; the first, relating to the 1932 records, was published in the *2nd Quarterly Circular* for 1933.

(b) *Foreign Clones.*—Until proved Ceylon material is available all commercial planting with budgrafts must be carried out with clones developed in other countries, and it is therefore important to keep a lively touch on the performance of these clones as periodically reported in foreign journals. All published data are carefully perused and information of particular interest to Ceylon planters presented in an annual series of reports. The second of this series, which included certain figures from the commercial tapping of large areas, was published in the *3rd Quarterly Circular* for 1933.

Particular interest is attached to the performance in Ceylon of the well known imported clones, and early yield records will shortly be available. In the meantime observations are being made on the growth and other characteristics shown by the various clones under different conditions.

The following girth measurements of some of the best clones are reproduced by courtesy of the Department of Agriculture. The buddings were planted as dormant budded stumps on the Iriyagama Division of the Experiment Station, Peradeniya, in October 1929, the seedlings being planted as basket plants at the same time. The clones are arranged in 5 randomised blocks, 12 trees of each clone to a block, so that a critical comparison is provided. The girth measurements were made at a height of 3 ft., measured from the union of the buddings, and from the ground in the case of the seedlings.

Clone	Average Girth in Nov. 1933.
Tjirandji I	11·62 inches
Seedlings	11·02 ,,
A.V.R.O.S. 49	10·45 ,,
Tjirandji XVI	10·36 ,,
Bodjong Datar 5 / A.V.R.O.S. 50	9·91 ,,
Sungei Reko 9	9·83 ,,
Heneratgoda 2	9·51 ,,
Tjirandji VIII	9·47 ,,

Features of interest in these figures are:—

1. The predominant position of Tjirandji I. This is in accordance with observations on most estates and in other countries.
2. The satisfactory growth made by Tjirandiji XVI, which has usually been found a very slow grower in the Kalutara District and elsewhere.
3. The fact that apart from Tjirandji I there is little difference between the figures for the other clones.
4. The growth of the seedlings has, on the whole, been somewhat faster than that of the buddings. Owing to the different planting material used, however, this comparison is rather difficult to interpret.

(c) *Test-pricking and early test-tapping.*—In an endeavour to develop a method for the early indication of future yields of unproved clones, 24 clones in a portion of the 1928 clearing at Nivitigalakele were selected for test-pricking and test-tapping. For the pricking test six trees of each

clone, with an average girth of 9-10 inches, were stabbed with a $\frac{1}{4}$ inch chisel at a height of 5 ft. The bark having previously been smoothed with sand paper and slightly moistened, the length of flow was measured for each tree. Up to 6 trees of each of these clones were also tapped during the same month, the trees being about 3 years old from the time of budding with a minimum girth of 12 inches. Tapping was on alternate days on a half-spiral cut at a height of 20 inches from the union. The trees were tapped on 15 days, and the average yield calculated from the last 10 tappings.

When the clones were placed in orders of merit according to the two methods it was clear that there was no correlation, the lists showing not even a general agreement. It is difficult to find an adequate explanation for this rather unexpected result, but it is evident that both methods cannot give a reliable indication of future yields. Whether either method is of value will be shown when the clones come into regular tapping. It is proposed to repeat the procedure at six-monthly intervals until the trees are large enough for regular tapping.

B. **Selection and Breeding.**

The Agricultural Assistant reports a small measure of progress with artificial pollination at Nivitigalakele. The technique employed gave reasonably successful results, but the work was hampered by the small number of trees in the required clones which were old enough to produce satisfactory flowers. Attempts to cross two promising Hillcroft clones on Stenness Estate were interfered with by *Oidium* infection, and in future every effort will be made to obviate this trouble by means of dusting the inflorescences with sulphur.

Legitimate seedlings from various Malayan clones have been established in the nurseries at Nivitigalakele during the last two years, and now await the acquisition of further land for transplanting to the field. Illegitimate seed from promising sources has also been planted for future selection.

Problems Connected with Mature Areas.

A. **Tapping.**

1. *Tapping Questionnaire.*

In view of the wide-spread interest in the various systems of double-cut tapping devised primarily to reduce costs, and the great importance of this subject in a time of acute depression, a questionnaire was circulated in March to all estates which had registered for the receipt of the Scheme's

publications. The response was most gratifying, and a considerable mass of valuable information, observations and opinions on double-cut tapping was received. An analysis was presented in a report published in the *3rd Quarterly Circular* for 1933.

Before the questionnaire was circulated the Scheme, in reply to numerous enquiries, had adopted an attitude of cautious approval; the opinion was expressed that while in most districts either the double-three or double-four system could safely and advantageously be employed in order to reduce tapping costs, it was too early to say whether they were likely to prove suitable for permanent adoption. This view was confirmed by the results of the enquiry, but it is now further believed that double-cut tapping, in the form most suited to the individual estate, may largely supercede the normal alternate day system in most districts. In certain localities, however, all forms of double-cut tapping appear to be unsuited to the specific environmental conditions, and on certain individual estates the bark reserves may not permit of simultaneous tapping on opposite sides of the tree.

Several estates have attributed difficulties in securing an attractive coloured crepe to the double-cut systems. Although there is no doubt that with the longer tapping interval the rubber tends to be yellower, it has sometimes been possible to demonstrate that the trouble was due, not to the tapping system, but to incorrect methods or inadequate accommodation in the factory. In general, difficulties with manufacture are not considered to offer a serious drawback to these tapping methods.

2. *Tapping Experiments.*

In 1932 yield recording was commenced from three plots of 25-30 trees each near the laboratories, this work being primarily intended to show the degree of variation to be expected from plots of equal size allotted at random. The plots were tapped throughout 1932 on a single cut on alternate days. In January 1933 two plots were put on to the double-four system, the dates alternating, while one was retained on alternate day tapping. Although in the absence of any effective replication a critical comparison of the two tapping systems is impossible, the existence of the previous records in 1932 bestows some value on the 1933 figures. From a crude calculation of the percentage increase or decrease on the 1932 figures it is concluded that the double-four system has been responsible for an increase in yield of about 5%. In rubber content, measured accurately by trial coagulations, the double-four system shows an advantage of 2-3 ozs. per gallon. The significance of these differences cannot be judged,

but it is to be noted that both double-four plots show approximately the same relative gain.

During the year tapping experiments to compare the double-three A.B.C. system with normal alternate day tapping were commenced by two estates in collaboration with the Scheme. The experiments have both been designed in accordance with our recommendations, and the results will be capable of statistical examination. In each case a number of double-three tapping blocks is compared with blocks tapped on a single half-spiral cut on alternate days, the arrangement being randomised. Each double-three block is divided into three portions which are tapped for twelve months and rested for six months in rotation. Each block contains the same number of trees, so that the number of trees tapped with two cuts is always two-thirds the number tapped on one cut.

The results from the two estates for the six-month period March-August, 1933, are summarised below, the yields being expressed as percentages (alternate day = 100%).

Estate	Tapping system	No. of tappings	Yield as percentage	d. r. c. lbs. per gallon	Bark consumption ins. per annum
A (dry district)	Double-three	52	104·7	4·04	5·25
	Alternate day	73	100	3·94	5·75
B (wet district)	Double-three	45	96·1	3·30	5·5
	Alternate day	64	100	3·47	5·5

It is to be noted that on Estate A, where the double-three system shows a slight advantage in respect of both yield and rubber content, the experiment was started in November 1932, so that half the trees tapped in the double-three blocks received the benefit of four months' rest. On Estate B, on the other hand, the double-cut tapping was only put in force in March 1933, the trees having received no previous rest. On both estates the double-three blocks were somewhat favoured as regards outturn of tappers, with the result that they received more than two-thirds the number of tappings. The differences in yield and rubber content are all of doubtful significance, and the experiments must be continued for some years before the respective merits of the two systems can be rightly assessed.

Arrangements have been made for measurements of bark consumption and renewal to be taken from a representative number of trees at six-monthly intervals. On Estate A the first measurements of bark renewal were made in September, and no significant difference between the two systems was shown.

Statements that bark renewal under double-four tapping is superior to that under the normal alternate day system have often been heard, and measurements apparently demonstrating this superiority have been made on several estates. The figures which we have had the opportunity of inspecting, however, though by no means valueless, have not borne the light of critical scrutiny. This superiority may indeed exist, but we consider that it is not yet proved. The matter is of considerable importance owing to the higher rate of consumption necessary with double-four tapping, and is to receive early attention on Dartonfield Estate.

B. **Replanting.**

Owing to the great importance to the Ceylon industry of determining whether old Rubber soils can be successfully replanted with high yielding budded material, a close touch is being kept on the progress of replanting operations on estates. Enquiries received from several estates contemplating such measures indicate a renewed interest in this problem in consequence of the brighter market prospects. All aspects of replanting are to receive the fullest investigation on Dartonfield Estate, and as mentioned above one experiment in a field of 7 acres has already been commenced.

C. **Soil Management.**

A close touch is being kept on developments in Malaya with regard to the methods of so-called "forestry cultivation". In the sense to which such methods are likely to be applicable under Ceylon conditions, "forestry cultivation" implies the growth and management of a mixed cover of natural species. Uudesirable plants such as "illuk", bracken, certain other grasses and ferns, stagmoss and woody plants are gradually eliminated, while soft, herbaceous plants are encouraged. On a number of estates visited in an advisory capacity such methods have been recommended for the improvement of areas where the soil has been so badly eroded and baked that the establishment of introduced leguminous plants would be impossible.

Soil Samples.—At the request of Rothamsted Experimental Station a series of samples of fertile and infertile Rubber soils was sent to England, together with notes on yield, growth conditions etc., in the areas from which the samples were collected. A report is expected in due course.

EXPERIMENT STATION, NIVITIGALAKELE.

General supervision of the work at Nivitigalakele was exercised during the year, an average of about 3 visits being made to the Station every month. Progress is reported in detail by the Agricultural Assistant, and most of the experimental work has been referred to above under the appropriate headings.

The budding of all clearings was completed early in the year, 123 Ceylon and 5 foreign clones being finally represented in the field. At the end of the year 378 trees, including budgrafts of 35 clones, marcots and control seedlings, were in regular tapping. Although certain clones show definite promise, no outstanding yields were recorded from the budgrafts. A large number of further buddings in the 1926 clearing await being opened for the trial of tapping systems.

An excellent cover of various leguminous cover plants and green manures has been maintained in most parts of the Station. There is definite evidence, however, that where the growth is exceptionally vigorous it has had a retarding effect on the young buddings. *Pueraria phaseoloides*, in particular, shows to disadvantage in this respect. A large quantity of green material was envelope-forked into the platforms during July-September, and the opportunity was subsequently taken of keeping the platforms clear of the most vigorous ground growth. Provision has been made for carrying out this work twice during 1934.

The nursery laid down in 1932 for providing budded stumps to smallholders has made excellent growth, and material can be made available for distribution in 1934.

III. ADVISORY WORK, CORRESPONDENCE ETC.

1. *Estate Visits.*—The following visits were made to estates:—

Advisory	. .	...	21
Experimental	...	...	18
Miscellaneous	...	...	6
			45

In addition, numerous visits were paid to Dartonfield Estate in connection with the experimental programme, and several mornings were spent inspecting blocks of jungle in company with the Director. Visits were also paid to the Tea and Coconut Research Institutes.

2. *Specimens and Enquiries.*—The number of disease specimens received for report has shown a gradual decrease in recent years. It is not easy to know whether this is mainly due to a better acquaintance with

diseases and their methods of control, or to a reduction in interest owing to the very limited funds available for treatment. An analysis of the advisory services rendered during the last few years indicates in no uncertain manner that *Fomes lignosus* causes far more trouble in the main low-country districts than any other single disease.

The botanical subjects eliciting the most frequent enquiries were tapping systems, cover crops under old Rubber, and budgrafting and related matters.

The number of enquiries dealt with was 120, apportioned as follows :—

Mycological	...	...	55
Botanical and Agricultural		...	65
			120

Total correspondence amounted to 686 inward and 721 outward letters.

3. *Co-operation with Malaya.*—Co-operation has been maintained with the Rubber Research Institute of Malaya by means of interchange of views and information with the Pathological, Botanical and Soils Divisions.

IV. PUBLICATIONS.

1. Further Yield Records in connection with *Oidium Heveae.* —*Quarterly Circular*, Vol. 10, Part 1.
2. Diseases of Rubber in Ceylon, 1932.—*Quarterly Circular*, Vol. 10, Part 1.
3. The Effect of Earth-Cowdung Mixtures on Renewing Bark. —*Quarterly Circular*, Vol. 10, Part 1.
4. Ceylon Clones I.—*Quarterly Circular*, Vol. 10, Part 2.
5. A Note on Sun-Scorch of Budgrafts.—*Quarterly Circular*, Vol. 10, Part 2.
6. "Double-Cut" Tapping Systems in Ceylon.—*Quarterly Circular*, Vol. 10, Part 3.
7. Proved Hevea Clones—II : Clones in Malaya and the Dutch East Indies.—*Quarterly Circular*, Vol. 10, Part 3.
8. The Value of a Uniformity Trial in Field Experimentation with Rubber. To be published in the Journal of Agricultural Science.

R. K. S. MURRAY,
Mycologist.

Rubber Research Scheme Laboratories,
Culloden,
Neboda,
31st January, 1934.

AGRICULTURAL ASSISTANT'S REPORT FOR 1933.

Charge of the Experiment Station, Nivitigalakele and its accounts was continued during the year. Certain field investigations and visits to estates in connection with the experimental work of the Scheme were undertaken.

THE EXPERIMENT STATION.

The Clearings.—With the completion, early in the year, of the two clones in the 1928 clearing, which for want of budwood, remained uncompleted in December 1932, the budding of all 3 clearings at Nivitigalakele was concluded except for supplies which may be required for replacing casualties. Supplying during the year was confined to the 1927 and 1928 clearings, a total of 92 budded supplies being planted out.

An experimental attempt to plant out supplies whose scion had been previously made to grow out to about 5 ft. and then cut back to 12 in. and planted just when the buds along the stumped scion were beginning to sprout, proved successful. Planting out was done in moderately wet weather. This method helps to make the supplies put out less backward in relation to the rest of the plantation than by planting out dormant supplies.

A number of new trees was brought into test-tapping from all 3 clearings. To the 112 trees tapped in 1932, 83 (less 1 damaged by wind) were added in April as they reached the required girth of 16 in. at 3 ft. and 184 in November, making a total of 378 trees in regular tapping at the end of the year. A maximum of 12 trees only of each clone was tapped. Further particulars appear in the report of the Mycologist who is in charge of this work.

Forking in green manure loppings along platforms was carried out in all clearings. This consisted of opening a deep furrow with a 15 in. green-manuring fork, pushing in the green loppings and covering. The entire length of the platforms excepting 2 ft. along their upper ridge and 4 ft. on either side of each rubber plant was forked. Application of artificial manures to the clearings has been discontinued for the present and it is hoped that considerable benefit will be derived from the green manuring.

The severe winds of May-June caused considerable damage particularly in exposed areas of the 1926 and 1927 clearings where budded plants were oldest. 21 trees were blown over from the roots, 40 had either their branches

or trunks broken, 49 had their crowns badly bent over and 40 were loosened at the roots and blown over to a slanting position, besides a number whose root-hold was severely disturbed. Damaged portions were sawn off and treated, and slanting and bent trees lightened on top, as necessity demanded, and straightened. It was interesting to note that every tree blown right over had an imperfect taproot and that the majority of trees with broken branches or trunks belonged to clone G.771 or L.1/15.

Budding and Attention.—Budgrafting was mainly confined to budding of supplies for the 1927 and 1928 clearings to replace dead and wind-damaged plants and to introducing budwood into the budwood multiplication nurseries from promising Ceylon mother-trees and from certain proved foreign clones. Budwood from the latter and from two Ceylon clones was also multiplied for requirements in 1934. The year's (*i.e.*, April to December) budding results are as follows:—

	Plants budded	No. successful	Percentage successful
Field ...	121	44	36·3
Nurseries ...	869	673	77·4
Total	990	717	72·4

The comparatively small amount of field budding executed was mainly in connection with various experiments which in certain cases entailed budding on to abnormal stocks and hence accounts for the low percentage of successes. The nursery budding on the other hand, which comprised the brunt of the year's work, gives a successful percentage of 77·4 as against 66·3 last year.

The work of cleaning out, disinfecting and treating budded stocks in the field, whose cut surfaces had tended to decay before the union had completely callused over, was completed in the 1927 clearing and all but 6 acres of the 1928. The six-monthly inspection of the experiment initiated last year to investigate this subject was duly carried out and material gathered for a report. The Mycologist's report for 1933 summarises some of the more outstanding conclusions arrived at. Following recommendations made by the Rubber Research Institute of Malaya and confirmed by our own observations, the final cutting down of budded stocks was done to a slope of 45°, which angle was found both to facilitate rapid callusing over of the cut-surfaces and to leave minimum chance of the snag starting to decay.

Pollination.—Artificial cross-pollination of Ceylon clones established at Nivitigalakele was personally carried out during February and March on a number of trees in the 1926 clearing which had flowered. Although the

trees available for this work were more than last year, by far the greater number was not sufficiently old to produce flowers and consequently restricted the scope of the work considerably. Out of a total of 822 individual pollinations carried out, 52 were successful, giving a successful percentage of 6·3. 18 pods out of this 52 were harvested, the remainder having either withered and fallen before reaching maturity or been blown down by the wind. 51 seed (out of the 18 pods) were put out to germinate, of which 14 germinated successfully, 7 of them being crosses between two budded Ceylon clones, 1 a cross between a budded Ceylon clone and an ordinary estate seedling tree and the remaining 6 crosses between two estate seedling trees (controls). The seeds harvested were for the most part abnormally small and this, together with the high proportion which fell before ripening and the low percentage of germination, is probably attributable to the immaturity of the trees. The 7 clonal crosses were planted out in December and, mentioning female parent first, are as follows :—

3 of	"Heneratgoda 2"	X "Marcot 52"
3 ,,	"Marcot 52"	X "Heneratgoda 2"
1 ,,	"Marcot 52"	X "Lavant 1/15"
7		

"Marcot 52" is the highest yielding vegetatively-propagated tree at the Experiment Station at present. The work during the latter part of the season was interfered with by the outbreak of *Oidium Heveae* on the inflorescences, and it was resolved to dust them with sulphur prior to commencing work next year.

Budding Experiment.—A small-scale experiment was carried out to ascertain the relative success, rapidity in shooting of the buds, and vigour of the shoots, by budding with (a) scale leaf buds and (b) leaf-scar buds. The results which were statistically examined by the Mycologist, though not significant, showed that type (a) gave better successes than type (b), thereby justifying the general preference for scale leaf buds in budding practice. Comparisons between rapidity of shooting and vigour of the shoots will be made in due course. In part 2 of this experiment (a) undamaged ingrowing buds, (b) slightly damaged ingrowing buds and (c) badly damaged ingrowing buds were compared to determine how far an ingrowing bud may be damaged on removal, which more often than not unavoidably occurs, without detriment to its success. The results, which were significant, showed that success from even a slightly injured bud, though possible, was likely to be greatly reduced.

Vegetative Propagation of Stocks.—The multiplication of uniform stocks vegetatively by "layering", which was not successful last year, was repeated. 12 vertical shoots (out of 58) which since they first shot out as buds along

the prostrated stems have been kept covered with earth, had rooted up to the moment of writing. "Ringing" the shoots with wire at the bottom has so far made no improvement in the rate of rooting. Cutting back the ends of the prostrated stems definitely accelerated forcing of their buds into growth.

Nurseries.—42 new clones, representing high-yielding Ceylon mother-trees, were introduced into the budwood nursery, bringing the total number of clones in it to 307, and leaving no space for further introductions. The nursery was pollarded in November to remove overgrown and produce fresh budwood. The chart of the nursery was revised to show the new clones introduced and the number of yards of budwood available on each plant as at December 1933.

The Tjikadoe seedlings were test-pricked. The results showed a distinct correlation between the length of flow obtained last year and this.

The seedling nursery for providing budded plants to small-holders was thinned down to approximately 7,000 plants and 3 of its beds utilised for multiplying budwood for use next year. The plants budded were later transplanted to other nurseries, owing to over-shadowing from their unbudded neighbours.

62 out of 193 selected seed (S.R.9) imported from Malaya germinated and 57 seedlings were successfully established. Approximately 6,000 ordinary seedlings were planted in nurseries to provide stocks for 1934.

Nitrogenous Plants.—A portion of the ground-cover, which as a result of the policy adopted last year had been allowed to grow over the platforms, had unavoidably to be cleared during forking of the latter in places where growth was too thick for the forks to penetrate. The cover has since spread over the platforms except in areas where, owing to the over-vigorousness of the *Pueraria*, it was decided to keep platforms clear of cover crop. Between platforms an excellent mixed cover of erect and creeping green manures has been maintained. *Pueraria phaseoloides* (*javanica*) which is a very vigorous grower has tended to smother out its less vigorous companions like *Vigna oligosperma* and *Centrosema pubescens*, and in certain fields has had to be thinned down for fear of competing with the rubber plants. Cuttings of *Pueraria* put out during suitable weather were found to take root readily.

An attempt was made to establish a semi-circular shade belt of erect green manure plants on the south-west side of each budded plant in the field, whose union had not completely callused over. This was done in order to protect the callusing bark at the union from sun-scorch during the next hot weather. Five varieties of seed were sown but growth was very sporadic on the whole, *Clitoria laurifolia* being the most successful.

Gliricidia rows were lopped to 3½ ft. and green manures pruned once throughout the Station, loppings being forked in as described earlier. Approximately 650 overshadowing *Albizzias* were lopped to 12 ft. 165 lbs. of green manure seed was collected and 86 lbs. sold.

Manure.—Manuring with artificial fertilisers was confined to supplies and nurseries. As in previous years all supplies were given ½ lb. of Black Label Animal Meal Mixture each at time of cutting down the stock to 6 ins. Seedlings in the small-holders' nursery were given 2/3 oz. per plant and 1 oz. per plant, in April and September respectively, of a mixture of Nicifos and Muriate of Potash mixed with Adco in order to secure vigorous stocks for budding on to. 437 scion-grown budded stumps of proved foreign clones, from which budwood will be required in 1934, were given ¼ to ½ lb. each, according to age and requirements, of the Animal Meal mixture, the manure being lightly forked in round the plants. 209 seedlings from imported Malayan seed and 355 ordinary seedling stocks were given 2/3 oz. per plant and 1/3 oz. per plant respectively of the Nicifos-Muriate of Potash mixture mixed with Adco.

Weeding and Mikania.—Weeding was satisfactorily carried out on contract by 2 to 3-monthly rounds according to conditions prevailing in each field. A saving was made on the total weeding vote for the year and partly expended on forking out patches of *Mikania,* which, owing to two repeatedly wet years, cost more than the sum estimated.

Staff and Labour.—The services of the second Budding Assistant were discontinued in March owing to the diminution in budding work resulting from completion of the clearings. The other members of the staff, consisting of the Conductor, Budding Instructor and Budding Assistant, have discharged their duties satisfactorily.

The Indian labour staff was repatriated with the exception of one man for sanitary duties. All field work has been carried out by local labour and several Sinhalese families are resident in the lines on the Station. The Station has continued to be exempted from acreage fees.

Pests and Diseases.—No serious damage from these sources was experienced. Sporadic cases of *Corticium salmonicolor* (pink disease) in the clearings and *Phytophthora palmivora* sp. in the nurseries occurred from time to time. *Achatina fulica,* the Kalutara snail, was responsible for killing out patches of cover crops during wet weather and had to be collected and destroyed.

Rainfall.—Monthly and total figures for 1933 and 1932 are given below :—

		1933	1932
January	...	7·25 in.	·97 in.
February	...	4·70 ,,	6·25 ,,
March	...	8·57 ,,	9·70 ,,
April	...	17·30 ,,	21·50 ,,
May	...	29·40 ,,	27·76 ,,
June	...	20·72 ,,	10·45 ,,
July	...	12·60 ,,	6·25 ,,
August	...	13·80 ,,	26·20 ,,
September	...	9·61 ,,	11·60 ,,
October	...	19·52 ,,	22·45 ,,
November	...	13·55 ,,	20·05 ,,
December	...	7·98 ,,	8·40 ,,
	Total	165·00 ,,	171·58 ,,

GENERAL.

Estates were visited during the year in connection with cross-pollination of Ceylon clones, inspecting and reporting on experiments conducted by the Rubber Research Scheme, and identification of clones. Assistance was also rendered in inspecting several blocks of Crown jungle in the Kalutara district in connection with the proposed expansion of the work of the Scheme.

W. I. PIERIS,
Agricultural Assistant.

Rubber Research Scheme Laboratories,
Culloden,
Neboda,
25th January, 1934.

REPORT OF THE LONDON ADVISORY COMMITTEE FOR RUBBER RESEARCH (CEYLON AND MALAYA) FOR 1933.

The Committee and Technical Sub-Committee each held four meetings during the year.

The Committee regret to report the death in January 1933 of Mr. W. A. Williams, a member of the Technical Sub-Committee, who had been associated with the London Advisory Committee of the Ceylon Rubber Research Scheme since its inception in 1915.

The Research Association of British Rubber Manufacturers determined their nomination of Mr. F. D. Ascoli as a representative of rubber manufacturers on his ceasing to be a member of the Board of Management of the Association, and the Committee decided to take no action regarding the filling of the vacancy for the time being.

Dr. W. Youngman, the Chairman of the Board of Management of the Ceylon Rubber Research Scheme, attended two meetings and also visited the laboratories. The Committee are glad to observe from his report to the Board of Management on returning to Ceylon that he was favourably impressed with the value of the work in London and the assistance rendered by the Committee.

Meetings of the Technical Sub-Committee were attended by Mr. R. O. Bishop and Mr. J. O. Hastings of the Chemical Division of the Rubber Research Institute, Malaya. These officers also worked for a short period in the London laboratories during their leave in England in order to obtain first-hand knowledge of the methods of testing adopted and the problems under investigation. Series of visits to factories and to representatives of different sections of the rubber trade were arranged with a view to placing them in touch with recent developments in the industry and in consumers' requirements likely to be of value in connection with the work of the Rubber Research Institute. The conferences held in 1932 with the Director of the Institute and the personal discussions with those officers have undoubtedly been of the utmost benefit in effecting improved liaison between the work in London and in the East, and have led to a fuller appreciation and much greater utilisation by the Rubber Research Institute of the services which can be rendered by the London Advisory Committee and its staff.

A considerable portion of Mr. Bishop's time was devoted to a study in conjunction with the London staff, of the marketing and possible developments in the use of rubber latex. During the course of these enquiries it

became evident that in view of the importance of the American market a complete review of the position could not be made without personal discussion with consumers in the United States of America and, in view of the time which would be involved in obtaining authority from the Rubber Research Institute for the expenditure consequent upon Mr. Bishop's return to Malaya *via* the United States, arrangements were made with the Technical Research and New Uses Committee of the Rubber Growers' Association to bear the cost of this visit. The Committee are of the opinion that the information obtained by Mr. Bishop in America should be of considerable value in connection with the technical research carried out on behalf of the planting industry and they hope that means may be found for maintaining regular personal contact with American consumers.

A copy of the report of the Commission of Enquiry into the affairs of the Rubber Research Institute of Malaya was received from the Secretary of State for the Colonies with an invitation to submit observations. The Committee had the advantage of discussing the report with the Chairman of the Commission, Professor F. A. Engledow and receiving from him detailed explanations of the recommendations. A communication was forwarded to the Secretary of State expressing approval of the report and suggesting that effect should be given to the recommendations as soon as possible.

At the request of the Institution of the Rubber Industry a meeting of the London Section was held at the Imperial Institute on the 27th November, 1933 in order that members connected with the sales side of the industry should obtain a first-hand acquaintanceship with the work on rubber being carried out on behalf of the Rubber Research Schemes of Ceylon and Malaya. Nearly 200 attended this meeting which proved to be of considerable interest not only to the sales section but to many technical members of the Institution. It received very favourable notice in the technical press and a number of useful new personal contacts were established with various manufacturing interests. After an inspection of the exhibits in the Ceylon and Malaya courts of the Imperial Institute Galleries, especially those dealing with rubber growing and preparation, two popular films showing the production of rubber were displayed. Three short papers of a non-technical character were then read by the staff, after which visits were made to the rubber laboratories where the research in progress was explained and demonstrations given of the methods of testing employed.

At the request of the Board of Management of the Ceylon Rubber Research Scheme advertisements were issued in various journals for an assistant chemist for research in Ceylon on the preparation and utilisation of raw rubber. The candidate provisionally selected by the Board of

Management (Mr. M. W. Philpott, B.Sc.,) was interviewed by the Committee and their suggestion, that in view of his previous experience, he should be offered a higher initial salary than that advertised was adopted by the Board of Management. Mr. Philpott will work in the London laboratories for a short period before sailing in April, 1934, to take up the post in Ceylon.

Finance.—The expenditure incurred in connection with the work in London during the year amounted to £2,882.15.1. After allowing for liabilities outstanding at 31st December, 1933, there was an unexpended balance in London of £350 and there was also a balance of £34.16.6 held on behalf of the Rubber Research Institute of Malaya from the funds supplied by them to meet expenditure incurred on behalf of the Institute.

Co-operation with other Organisations.—Mr. G. Martin continued to serve as a representative of the Research Association of British Rubber Manufacturers on the Joint Committee of that Association and the British Electrical Research Association dealing with the quality of ebonite. A study is being made by the Joint Committee of the effect of different types of raw rubber and special sets of samples with low moisture absorption were asked for from Malaya with a view to determining the possibility of producing ebonite with improved dielectric properties. Assistance was rendered by the London Committee in the preparation of the handbook of Physical Constants which the Research Association is undertaking on behalf of the Rubber Growers' Association.

During the year contact was made with the India-rubber Manufacturers' Association. A conference was held with representatives of their Technical Committee to discuss representations made by the Association as to the possible effect on the raw rubber of the use of certain chemicals on estates. As a result of arrangements made at this Conference a detailed investigation of the subject was undertaken in conjunction with the staffs in Ceylon and Malaya.

The special grant from the Technical Research and New Uses Committee of the Rubber Growers' Association for the development of applications of unvulcanized rubber crumb was continued and work on the subject is still in progress. A report was supplied to the Rubber Growers' Association towards the end of the year containing a detailed account of the investigations, and copies of this report were forwarded to the Rubber Research Scheme (Ceylon) and the Rubber Research Institute (Malaya.)

In conjunction with the Rubber Producers' Research Association steps were taken to obtain English patents for the processes for the preparation of crumb rubber and other inventions arising out of the work of the staff in London.

Applications granted :—

395774—A new and improved process for the preparation of soft rubber.

395775—Process for the preparation of unvulcanised India-rubber in crumb or powder form.

396880—Improvements in and relating to the manufacture of unvulcanised India-rubber from rubber latex.

Applications filed :—

34181/32—Process for the preparation of unvulcanised India-rubber in granular form.

20653/33—Improvements in and relating to the manufacture of rubber.

35277/33—Improvements in and relating to the manufacture of rubber.

835/34—Improvements in and relating to the preparation of rubber and road-tar mixtures.

4224/34—Improvements in and relating to the concentration of latex.

Authority was given to the rubber research organisations in Ceylon and Malaya to import the above inventions if they so desire.

Investigations.—Particulars of the investigations completed and in progress during the year are given in the appendix. The following reports were forwarded to Ceylon and Malaya :—

1. *The Technical Advantages of Reclaim and their bearing on the Preparation of Rubber.*—Popular summary of paper dealing with detailed investigations of several types of reclaim in the Committee's laboratories read by Mr. Martin before the Institution of the Rubber Industry (London Section) March 1933.—(Published in the Bulletin of the Rubber Growers' Association May 1933) published in the *Second Quarterly Circular* of the Rubber Research Scheme (Ceylon).

2. *Clone Rubber from Ceylon.*—12 samples from Hillcroft clones 28 and 34.

3. *Duprene.*—A synthetic material resembling rubber in some of its characteristics and for which specific advantages are claimed.

4. *Hot Water Treatment of Coagulum Rolled to Sheet.*—Samples prepared by Mr. O'Brien with a view to comparing the effect of this treatment on crepe and sheet.

5. *Rubber packed in bales and dusted with powder.*

6. *"Softened" Rubber.*—Prepared by the Ungar and Schidrowitz process. (Published in the *Fourth Quarterly Circular* of the Rubber Research Scheme (Ceylon).

7. *The effect of adding plastogen to latex on the plasticity of rubber.*—Samples received from Rubber Research Institute, Malaya.

8. *Sheet rubber containing different amounts of bitumen.*—Forwarded by the Rubber Research Institute, Malaya, in connection with experiments with a view to obtaining a material as "dead" as reclaim.

9. *Effect of storage on the properties of rubber.*—Series of samples prepared by Department of Agriculture, Federated Malay States, in 1916-1917.

10 *Soft air-dried sheet prepared by Rubber Research Institute, Malaya, by the coagulation with papain of skim from centrifuged latex.*

11. *Crepe prepared in Malaya by heating latex in an autoclave*—forwarded for determination of its suitability for manufacturing purposes particularly as regards ease of manipulation.

12. *Suitability of wooden barrels as containers for field latex.*

13. *Examination of latex concentrated by creaming.*—Reports at intervals throughout the year.

The rubber research organisations in Ceylon and Malaya were also kept fully informed of important latex developments.

F. J. BURGESS,
Chairman.

J. A. NELSON,
Secretary.

Imperial Institute,
London, S.W.7.,
29th March, 1934.

The composition of the London Advisory Committee for Rubber Research (Ceylon and Malaya) at the end of 1933 was as follows :—

Member nominated by the Colonial Advisory Council of Agriculture and Animal Health.

Mr. F. A. Stockdale, C.M.G., C.B.E.

Member nominated by the Government of Ceylon.

Lt.-Col. Sir David Prain, C.M.G., C.I.E.

Member nominated by the Governments in British Malaya.

Mr. J. Lornie, C.M.G.

Members representing Malayan Planting interests—nominated by the Rubber Growers' Association.

Mr. P. J. Burgess, (Chairman).
Mr. W. J. Gallagher,
Mr. H. Eric Miller.

Members representing Ceylon Planting interests—nominated by the Rubber Growers' Association.

Sir Herbert Wright.
Mr. G. H. Masefield.
Mr. George Brown.

Member representing Manufacturing interests.

Lt.-Col. J. Sealy Clarke.

Ex-Officio Members :—

Lt.-Gen. Sir William Furse, K.C.B., D.S.O., Director of the Imperial Institute.

Professor V. H. Blackman, Director of the Botanical Laboratories, Imperial College of Science and Technology.

Dr. E. J. Butler, C.M.G., C.I.E., Director of the Imperial Mycological Institute.

Sir John Russell, O.B.E., Director of the Rothamsted Experimental Station.

The Technical Sub-Committee consisted of members of the Advisory Committee with the following co-opted members :—

Mr. G. Martin, (Superintendent of Rubber Investigations).
Mr. B. D. Porritt.
Mr. I. D. Patterson.
Mr. H. W. Ridley,
Mr. W. C. Smith.
Dr. D. F. Twiss.

APPENDIX TO REPORT OF LONDON ADVISORY COMMITTEE. 1933.

(1) Latex.

In view of the important developments which are rapidly taking place in the use of rubber latex, considerably more attention than in previous years was devoted to problems relating to methods of concentrating and testing latex.

The first of the experiments on concentration was carried out by a modification of a well-known method at the request of the Rubber Research Institute of Malaya, and in personal co-operation with Mr. Bishop during his leave in this country. Satisfactory results were obtained and arrangements have now been made to continue the work on a larger scale.

During these experiments it became obvious that some commercial consignments of latex (38 to 40 per cent. dry rubber content) of poor quality were arriving in this country and that recognised methods should be prescribed for determining quality in order to avoid prejudicing developments of new uses of latex outside the rubber manufacturing industry by preliminary trials with unsatisfactory material. About the same time particulars were received from the Rubber Growers' Association of proposals for a quality specification which had been submitted to the Association. A special study of the subject was accordingly commenced and up to the present the work has been concentrated on tests on the following properties :—(a) strength of dry films (b) stability, and (c) viscosity. The film strength test is strongly recommended by a large firm interested in latex as a result of their practical experience, but experiments in the Committee's laboratories showed that the results given by this test are markedly affected by a number of factors which require accurate control in order to obtain reliable figures. A stability test based on information received from various sources has been developed and is now used for the routine testing of samples of latex. A satisfactory method of measuring the viscosity of latex has not yet been evolved, but a number of promising methods are being explored. A quality specification for latex is very desirable, but more experience with testing methods is necessary before making definite recommendations and the matter is still under consideration.

A number of new contacts were made with latex consumers in Great Britain during the year in the course of which attention was called to the demand for a type of concentrated latex not on the market. Experiments

were carried out in the London laboratories where a method was developed with a view to obtaining a suitable product. Satisfactory reports were received on small samples submitted to various consumers and material for works trials is now being prepared. Suggestions have also been made for experiments in the rubber research laboratories in Ceylon and Malaya.

It was shown by the Rubber Research Institute that gum tragacanth varies considerably in its power to cream latex. Nearly thirty samples representing a wide range of commercial grades, were therefore obtained from dealers in London and tests as to their ability to cream ammonia-preserved latex. Approximately one-third of the samples, including several of the cheaper grades, proved to be excellent creamers and one-third definitely poor creamers. The good creamers formed viscous solutions but there was no definite relation between creaming power and viscosity or between creaming power and mineral constituents. Tests on a further consignment confirmed that some of the cheaper grades were excellent creamers and samples of these were therefore despatched to Malaya for further examination by the Rubber Research Institute.

Series of samples of latex concentrated by modifications of creaming methods received from the Rubber Research Institute were examined in the London laboratories and submitted to consumers for works trials. Some of the samples were satisfactory and the methods could be recommended if the patent position were clear.

A sample of 38 to 40 per cent. latex preserved with ammonia at the Rubber Research Institute was shipped in a 40-gallon wooden cask made from local material. An appreciable amount of evaporation occurred during transit, but this method of shipment is of particular interest because of the excellent colour of the latex, presumably due to the absence of contact with a metal container.

(2) Types of Rubber Required by Manufacturers.

(a) Soft Rubber.

Progress was made in a number of directions in the study of methods of preparation of types of rubber to suit the requirements of manufacturers for definite purposes; and special attention was paid to the production of soft, easily manipulated rubber for which there should be a large demand if a satisfactory product can be obtained.

The examination of the "softened" rubber prepared by the oxidation of coarsely disintegrated rubber (Ungar and Schidrowitz process) and referred to in the last annual report was completed. The rubber was softer and more easily manipulated without preliminary treatment than estate crepe and sheet submitted to the usual masticating process. Its

mechanical and ageing properties after vulcanisation in a rubber-sulphur mixing were rather poor, but in a number of technical mixings excellent results were obtained, and for some purposes the rubber appears to have good commercial prospects if offered at a suitable price.

As rubber is frequently softened by manufacturers by mixing with well-known softeners during milling, it seemed possible that a satisfactory soft rubber could be prepared by adding emulsified softeners to latex. Although a wide range of both popular and little used softeners was tried in experiments in London using ammonia-preserved latex, the effect on the manipulative properties of the dry rubber was much milder than in the oxidation treatment employed in the Ungar and Schidrowitz process, and there appeared to be no advantage in adding the softeners to the latex over the present practice of mixing them with crepe or sheet during manufacturing operations. The feasibility of adding softeners to latex followed by oxidation of the dry rubber was then considered, but it was found that the softeners frequently retarded oxidation and it was not possible to produce a very soft rubber without heating it in air to an extent not materially different from that employed in the absence of softeners.

Other modifications of the oxidation method of softening rubber gave more promising results. The experience gained enabled suggestions to be made for further work in the East with fresh latex.

Experiments were also made on the use of rubber as a softener, after heating for some time at about 240°C. The softening effect of molten rubber on crepe and sheet was not so marked as expected, but the molten rubber could be easily emulsified in the presence of ammonium stearate and ammoniacal casein to form a type of artificial latex which could be mixed with natural latex. The rubber obtained by mixing the latices was softer than usual but a considerable amount of molten rubber latex would have to be added to obtain a product as soft as the oxidised rubber prepared by the Ungar and Schidrowitz process.

It was also found that compounding ingredients could be easily mixed with molten rubber by stirring and that after vulcanisation, products with a fair strength were obtained. This process may have commercial applications but it involves the development of a new technique to which so far it has not been possible to devote attention.

A number of samples of soft rubber prepared by the addition of emulsified softeners to latex were received from the Rubber Resarch Institute of Malaya for examination, but as in the case of the above investigation of samples prepared in London from preserved latex, the materials were not sufficiently soft to be of definite commercial interest. Rubber prepared by

coagulating latex by heating it about 150°C in an autoclave was more promising but the rubber was by no means as soft as the oxidised rubber already on the market and the R. R. I. stated that the method of preparation was not without difficulty.

A soft rubber prepared at the R. R. I. by a novel method was not so soft as oxidised rubber. The physical and mechanical properties after vulcanisation were satisfactory but the ageing properties were inferior to those of ordinary sheet or crepe. The study of this method is being continued.

Reference was made in previous reports to the preparation of soft rubber by a chemical treatment of latex which did not involve oxidation. The method consists in the addition of a little sodium nitrite to latex prior to coagulation, and has since been described in E.P. 3197. In view of the interest of certain manufacturers a small consignment was prepared by the Rubber Research Scheme, (Ceylon) for technical trials. The reports indicated that there is little hope of using this type of rubber for general manufacturing purposes. It has however unique properties and may be of value outside the rubber manufacturing industry. In subsequent experiments in London a greatly improved product was obtained by a modification of this method and particulars of the process were forwarded to the rubber research organisations in the East for investigation with fresh latex.

Attempts to prepare soft rubber by treating latex with a solution of hypochlorite were made by the Rubber Research Institute, Malaya, but the examination of the samples in London showed that the effect of the hypochlorite was too small to be of commercial value. The possibility of obtaining improved results by a modification of the method was suggested by the Technical Sub-Committee.

(b) **Water absorption.**

Co-operation was again maintained with the Research Association of British Rubber Manufacturers and the Electrical Research Association in their joint investigation of the quality of ebonite in connection with which the preparation of rubber with low moisture absorption may play a prominent part.

The study of the water absorption properties of a comprehensive range of estate crepe and sheet from Ceylon which was completed during the year showed that some of the samples absorbed four times as much water as others. This emphasized the importance of carrying out the tests previously suggested on the effect of different types of rubber, particularly rubber with low water absorption on the quality of ebonite. Arrangements were accordingly made for experiments to be carried out in the East with a view to the preparation of suitable material for technical trials.

Rubber prepared from very dilute latex which was received from the Rubber Research Institute, Malaya was found to offer little advantage as regards water absorption, but it is understood that other methods of preparation which are under investigation by the Rubber Research Institute are proving to be more satisfactory.

(c) **Sulphuric Acid.**

Economic conditions in the plantation industry have led to the use on some estates of sulphuric in place of formic or acetic acid as a coagulant of latex and the India Rubber Manufacturers' Association expressed their concern to the Committee at the possibility of the extended use of this chemical. After consultation with the Association arrangements were made for samples to be obtained from Malaya so that the effect of the use of sulphuric acid might be studied. Investigation on these samples in the Committee's laboratories and the report on a duplicate set which was furnished by the India-rubber Manufacturers' Association showed that when sulphuric acid was used in the correct proportions it had no harmful effect upon the rubber, but that it would be necessary for manufacturers to make small adjustments of vulcanising periods. At the close of the year the Committee were in communication with the Rubber Research Institute as to the recommendation to be made to estates with regard to the use of this coagulant.

(d). **Paranitrophenol.**

The India Rubber Manufacturers' Association also drew attention to the fact that the use of paranitrophenol in crepe preparation caused rubber articles made therefrom to stain the package in which they were wrapped. On making enquiries in the East it was found that paranitrophenol was not being employed for crepe preparation in Malaya and was only in use on one estate in Ceylon where it was definitely helpful in producing rubber of satisfactory appearance. Tests carried out in the London laboratories and on behalf of the India Rubber Manufacturers' Association with rubber from this estate showed that articles manufactured from it were liable to stain paper in which they were wrapped when kept in a damp atmosphere.

(e) **Hot Water Treatment of Coagulum.**

Previous experiments in Ceylon have shewn that in some cases the colour of crepe is improved by immersion of the creped coagulum for a short period in hot water and tests in London that the rubber is of satisfactory quality and somewhat softer than average Ceylon crepe. As occasional samples of estate crepe are extremely hard and difficult to manipulate by manufacturers it appeared likely that the hot water treatment would overcome this difficulty, but extensive experience over a long period would be necessary to prove that the rubber possessed this advantage.

Before attempting preparation on a more extensive scale it appeared desirable to obtain the views of manufacturers on the properties of crepe which had received the hot water treatment and a consignment prepared in Ceylon was submitted to four different manufacturers who reported that the rubber was satisfactory. In view of these reports the Committee are of opinion that the method could be safely employed on a more extensive scale.

It is not likely that the rubber would command a premium and therefore the method of preparation is not suitable for general adoption if it involves an increase in cost over the standard method. On the other hand if the method were more widely adopted and the rubber had the advantage as regards manipulation already suggested, a special demand might arise when the merits of the rubber became fully established.

A series of samples was also received from Ceylon in which sheet coagulum was submitted to the same treatment but it was found to offer no advantages.

(3). **Old Rubber.**

Little information is available as to the effect of storage on the intrinsic properties of rubber although in some cases it may be necessary to store rubber for considerable periods. It was found in vulcanisation tests of the Committee on samples which had been kept at a London wharf from three to fourteen years that there was a gradual deterioration in ageing properties in a rubber-sulphur mixing, but as full information regarding the origin of the samples was not available it was considered undersirable to publish the results. A series of crepe samples prepared by Eaton & Grantham at the Department of Agriculture, Malaya, in 1916-1917 was subsequently received. Tests on these samples indicated that rubber in crepe form deteriorates slowly on keeping in the Tropics; this deterioration is characterised by a gradual softening of the rubber and the development of poor ageing properties after vulcanisation in a rubber-sulphur mixing. Although this deterioration would not be so marked in the technical mixings largely used by manufacturers it appears desirable to use rubber as soon as possible after preparation.

(4). **Clone Rubber.**

Information concerning the properties of rubber from different clones is gradually being extended as material for test becomes available. During the year samples were received from two Ceylon clones on which tapping had commenced. The trees were too young to draw satisfactory conclusions as to the quality of the rubber but the results obtained will be useful for

comparison with those given by rubber from other clones of a similar age and rubber from the same clone when the trees are more mature. As more trees and other clones come into tapping in the East a considerable amount of time will have to be devoted in London to the examination of clonal rubber.

(5). **Duprene.**

Since the beginning of the present century there have been several attempts to produce synthetic rubber on a commercial scale, but in all cases the material proved inferior in quality to natural rubber from *Hevea brasiliensis*. A novel form of synthetic product has obtained prominence, recently marketed under the name of Duprene because of the advantages claimed for it over plantation rubber as regards resistance to oil absorption, moisture absorption, gas diffusion, heat and sun-cracking.

These claims were generally confirmed in tests in the Committee's laboratories, but the mechanical properties of Duprene were not equal to those of rubber in the mixings employed, and the "vulcanised" Duprene became extremely hard on keeping for a few weeks. Duprene is a new material which it is understood is being sold at $1.00 per lb. in America and the present output is about 10 tons per month. It is however reasonable to expect that further research will result in reduced cost and an improved product, but even then it is unlikely that it will replace plantation rubber for most manufacturing purposes. Duprene undoubtedly has advantages for special purposes but its price is high and further research may improve rubber products so as to make them equal to, or better than, Duprene in the directions in which at present it shows some advantages.

(6). **Packing.**

In connection with the enquiry carried out in 1932 with the help of the Research Association of British Rubber Manufacturers as to the types of rubber required by manufacturers, a suggestion was received that rubber should be dusted with a surface lubricant before packing in order to facilitate separation of the sheets in this country. At the request of the Committee the R. R. I., Malaya, prepared samples dusted with surface lubricants and baled in different materials as it was desired to ascertain whether the massing which is usually experienced with bales would be avoided by dusting. Dusting prevented the massing of the rubber somewhat but its effect was not sufficient to enable the sheets to be pulled apart as easily as most rubber packed in cases, which is also difficult to separate and frequently causes trouble to the wharves and the smaller manufacturers who have no machinery for handling large blocks of rubber. It is therefore proposed to carry out further experiments to determine whether any improvement will be effected by dusting rubber packed in cases.

(7). **Rubber Crumb.**

In the report for 1932 an account was given of two methods of preparing rubber in crumb form devised by the staff in London, and of the factors likely to limit its use in the rubber industry unless it can be offered at a price similar to that of crepe or sheet. As the cost of preparation and shipment will not render it remunerative to offer supplies at the price of standard grades of plantation rubber attention was devoted during the year to the possibility of finding a use for the material outside the rubber industry particularly for road surfacing. The results of a comprehensive series of laboratory tests carried out in association with an important firm of manufacturers indicated that in certain circumstances the crumb confers distinct advantages but a considerable amount of further laboratory work followed by technical trials will be required before any opinion can be expressed as to whether a process suitable for use on a large scale under ordinary working conditions can be devised.

Recently considerable publicity has been given to two processes invented in Holland for the preparation of raw rubber in the form of crumb. In one process the latex is sprayed on to a moving band from which it is removed mechanically in the form of crumb; this material consists of whole rubber together with a little dusting powder and could be utilised for most manufacturing purposes. In the other process latex containing 30 per cent. dextrine (calculated on the dry rubber) is dried by spraying in hot air. The presence of this amount of dextrine would probably render the material unsuitable for many purposes in the rubber industry, but it is in the form of a very fine powder and may therefore find an outlet for special purposes for which the coarser forms of crumb would be less suitable. It is claimed for both of the Dutch processes that the products are likely to be in considerable demand but, although both differ in certain respects from the crumb prepared in the London laboratories, tests carried out from samples received from the inventors indicated that the materials are likely to present similar difficulties in obtaining an extensive outlet in the rubber manufacturing industry unless supplies can be made available to manufacturers at a price similar to that of crepe or sheet. In this event the facility with which rubber crumb can be handled should appeal strongly to manufacturers.

G. MARTIN,
Chemist & Superintendent.

Imperial Institute,
London, S.W.7,
29th March, 1934.

AUDITOR-GENERAL'S REPORT FOR 1933.

Audit Office,
Colombo, 2nd March, 1934.

The Chairman,
Board of Management,
Rubber Research Scheme (Ceylon),
Peradeniya.

Sir,

I have the honour to report that the audit of the accounts of the Rubber Research Scheme for the year 1933 has been completed and have pleasure in forwarding the following documents duly certified :—

(a) Income and Expenditure Account for the year 1933.

(b) Balance Sheet as at December 31, 1933.

I. Income.

2. The total income accrued during the year amounted to Rs. 186,652. It exceeded the estimate of Rs. 113,750/- by Rs. 72,902/- and the revenue of the previous year by Rs. 37,386/-. The increase is due to increased cess collections and to profit from the working of Dartonfield Estate since August, 1933.

3. *Cess Collections.*—The amount accrued for the year was Rs. 176,761/- inclusive of the collections made by the Principal Collector of Customs during December, 1933, but received in January, 1934. It exceeded the estimate of Rs. 105,350/- by Rs. 71,411/- and the increase is due to a rise in the quantity of rubber exported.

4. *Interest.*—The amount accounted for during the year was Rs. 7,599/-. It fell below the estimate of Rs. 8,000/- by Rs. 401/-. The shortfall is due to reduced rates of interest allowed by the Banks.

5. *Sale of Publications and Subscriptions.*—The amount realised for the year was Rs. 312/- as compared with Rs. 213/- of the previous year.

6. *Profit from Dartonfield Estate.*—The total income of the estate from August to December 31, 1933, was Rs. 6,652/- exclusive of Sale Charges of Rs. 619/-. The expenditure incurred in working the estate

amounted to Rs. 4,936/- leaving a nett profit of Rs. 1,716/-. The Estate Returns in support of expenditure and Sale Statements in support of income were examined.

II. Expenditure.

7. The total expenditure on Revenue Account exclusive of the amount allowed for depreciation on capital assets amounted to Rs. 75,148/- as compared with Rs. 76,337/- of the previous year. Details of this expenditure are fully set forth in the Income and Expenditure Account. The audited statements of expenditure by the London Committee in support of the contribution of Rs. 18,602/- made by the Board have not yet been received. The expenditure charged to Capital Account amounted to Rs. 90,079/- inclusive of Rs. 83,889/- spent on the purchase of Dartonfield Estate, Rs. 248/- on the nursery work in this Estate and Rs. 4,908/- on account of the Development of Experiment Station at Nivitigalakele.

8. A statement showing the excesses and unspent balances on votes with the explanation of the Director of Research for the principal variations is given below. Sanction for the excesses has to be obtained.

	Estimate	Actual Expenditure		Savings	Excess
		Rev. A/c.	Cap. A/c		
	Rs.	Rs.	Rs.	Rs.	Rs.
1. Personal Emoluments :—					
(a) 1-3 Technical Officers.	35,493	35,716	—	—	223
(b) 4-10 Subordinate Staff.	6,605	6,344	—	261	—
(c) 11 Rent Allowance	380	332	—	48	—
(d) 12 Provident Fund Contribution.	2,135	1,522	—	613	—
11. Other Charges :					
(a) 13 Laboratory :					
A. Upkeep, Chemicals and Apparatus.	2,000	594	605	801	—
B. Apparatus from London.	1,000	340	145	515	—
C. Samples for Imperial Institute	500	390	—	110	—
D. Dusting Experiments.	600	408	—	192	—

	Estimate	Actual Expenditure		Savings	Excess
		Rev. A/c.	Cap. A/c		
	Rs.	Rs.	Rs.	Rs.	Rs
E. Routine tests on Chemicals	200	—	—	200	
(b) 14 A-E Buildings	2,350	1,776	284	290	
(c) 15 Office:					
A. Printing and Advertising	1,500	1,758	—	—	258
B. Stationery	1,000	756	—	244	—
C. Postages	1,000	946	—	54	—
D. Books and Periodicals	500	552	—	—	52
E. General Charges	500	331	—	169	—
F. Audit and Accountancy	300	246	—	54	—
G. Telephones	480	410	—	70	—
(d) 16 Travelling:					
A. Staff	4,000	2,674	—	1,326	—
B. Board Members	1,000	1,317	—	83	—
(e) 17 Experiment Station:					
A. Development and Upkeep	5,886	135	4,908	843	—
III. Special Charges:					
(a) 18 London Advisory Committee's Expenditure	18,900	18,602	—	298	—
Sinking Fund	1,800	—	—	1,800	—
IV. Depreciation	4,550	5,765	—	—	1,215
V. (a) Dartonfield Estate	85,000	—	83,889	1,111	
(b) Dartonfield Estate Agricultural Development	250	—	248	2	—

Savings.

I (b) Office peon not employed.
I (d) Error in estimating.
II (a) A and B. Postponement of Expenditure.
II (a) C. and D. Over-estimate of requirements.
II (a) E. No samples of chemicals received for analysis.
II (b) A to E. Economies.
II (c) A. Economies.
II (c) E. Reduction in transport.
II (d) A. Over-estimate of requirements.
II (c) 17. Economies.
III Sinking Fund. Please see paragraph 10.
V (a) Over-estimate of expenses of transfer.

Excesses.

I (a) Change of incremental date under the Mycologist's new service agreement.
II (c) A. Cost of press advertisements for Chemist, Estate Superintendent, etc.
II (c) D. Under-estimate of requirements.
IV Depreciation allowed on London Plant.

Sanction has also to be obtained for the excesses on the following subheads under the votes for Experiment Station Development and Dartonfield Estate :—

I. Experiment Station Development Account.

General Charges.

		R. c.
14.	Tools, general	18·70

Working Expenditure.

2.	Pests and Diseases	19·33
7.	Manure	6·73
9.	Illuk Mikania	26.24
16.	Nurseries	31·97
17.	Tapping	19·22

II. Dartonfield Estate.

3.	Subordinate Staff	40·00
5.	Commission on Cash, etc.	7·65
6.	Subscription to C. E. P. A.	8·50
7.	Contingencies	9·63
11.	Scavenging	1·43

			R. c.
12.	Lines	... ...	8·78
43.	Tapping Implements	... ...	44·16
50.	Curing Materials	... ...	145·74
57.	Transport to Colombo	... ...	9·33
66.	Weeding Deniya	... ...	9·92

III. Balance Sheet.

(a) *Liabilities.*

9. *Sundry Creditors—Rs. 2,687/-.*—So far as it can be ascertained all outstanding liabilities on December 31, 1933, have been brought to account with the exception of the cost of audit for 1933 amounting to Rs. 382·37.

10. *Reserve Fund for Bonus and Passages.*—The balance of this account on December 31, 1932, was Rs. 5,955/. A sum of Rs. 1,410/- was paid during the year on account of bonus to one officer, leaving a balance of Rs. 4,545/-. No more payments on account of bonus are due to be made from this fund. Although a sum of Rs. 1,800/- being one-fourth cost of six return passages to England was provided in the estimates for transfer to the Passage Fund in 1933, it appears that the transfer has not been made in view of the big unexpended balance lying to the credit of this fund.

11. *Provident Fund Rs. 5,488/-.*—The balance on December 31, 1932, was Rs. 1,827/- The Contributions made by the officers during the year amounted to Rs. 2,139/-. The Board's contributions amounted to Rs. 1,522/- of which Rs. 1,477/- represented the bonus equal to the sum contributed by the members during 1932 and Rs. 45/- the interest on the balances of the fund for 1932.

12. *Depreciation Cash Reserve Account—Rs. 22,009/.*—The deductions amounting to Rs. 16,244/- made for depreciation from the value of the assets as from August 1, 1930—the date on which the new Board of Management was constituted—have been shown under the Depreciation Reserve Account and the value of the various assets has been restored to the original amounts. The amount provided for depreciation during the year was Rs. 5,765/-.

13. *Saleable Books Reserve Account.*—The balance of this account on December 31, 1932, was Rs. 4,587/-. It has been reduced to Rs. 2,347/- by the sale of books to the value of Rs. 65/- and by the writing-off of the value of obsolete books amounting to Rs. 2,175/-.

14. *Contribution to Capital Outlay.*—In respect of the capital expenditure on buildings, laboratory apparatus and furniture, a sum of Rs. 46,550/- representing but a portion of the total cost had been credited

to 'Permanent Reserve Account' on the suggestion of the Auditors who were in charge of the accounts prior to 1930. This Reserve Account as has been pointed out at the Board's meeting held on 23rd March, 1933, is not a cash reserve, and as it is neither a reserve against the full value of the capital assets I have replaced it by 'Contribution to Capital Outlay Account' to include the total amount of capital expenditure with a view to showing under "Surplus Account" only the liquid assets. Accordingly, the balances at December 31, 1932, of Rs. 46,550/- on the Permanent Reserve Account, of Rs. 90,984/- on Experiment Station Reserve Account and of Rs. 6,484/- on London Plant Reserve Account have been transferred to this account. The differences between the actual cost of the assets and the amounts provided in the reserve account against these assets amounting to Rs. 31,779/-, together with the capital expenditure of Rs. 90,079/- during the year have been added to this account making a total of Rs. 265,876/- .

15. *Surplus Account.—Rs. 225,336/-.*—The excess of revenue over expenditure during the year exclusive of capital expenditure was Rs. 105,739/-. The Capital Expenditure amounted to Rs. 90,079/-. The net surplus for the year therefore was Rs. 15,660/-. This is added to the amount of Rs. 241,455/- brought forward from 1932, from which a sum of Rs. 31,799/- has been transferred to 'Contribution to Capital Outlay Account' being the difference in value of assets included in the Reserve Accounts for buildings, laboratory apparatus, water supply, furniture and plant.

(b) *Assets.*

16. *Buildings.*—The balance on December 31, 1932, was Rs. 45,748/-. The sum of Rs. 7,225/- written off for Depreciation from August, 1930, to December, 1932, has been restored to this account and the expenditure during the year amounted to Rs. 67/- making a total of Rs. 53,040/-.

17. *Laboratory Apparatus.*—The balance on December 31, 1932, was Rs. 1,872/-. The amount of depreciation deducted since August, 1930, to December, 1932, and since restored was Rs. 3,264/- and the purchases during the year amounted to Rs. 749/- making a total of Rs. 8,952/-.

18. *Water Supply.*—The balance on December 31, 1932, was Rs. 1,872/-. The amount of depreciation deducted since August, 1930, and now restored was Rs. 532/- making a total of Rs. 2,404/-.

19. *Furniture, Fittings and Office Equipment—Rs. 9,132/-.*—The balance at the end of the previous year was Rs. 7,059/-. A sum of Rs. 1,856, being depreciation from August 1930 to December, 1932, was

restored to this account. The purchases during the year amounted to 217/-. A departmental verification of all the inventory articles was held during the year and a report forwarded to this office.

20. *Development of Experiment Station.*—The expenditure under this head during the year amounted to Rs. 5,043/-. Of this amount Rs. 135/- representing upkeep charges of buildings has been written off against revenue, and the balance has been added to the figure of Rs. 90,984/-, at which the Development account stood at the end of 1932. The balance of Rs. 984/- under Land Acquisition Account has been transferred to this Account making a total of Rs. 96,877/- at December 31, 1933.

21. *Dartonfield Estate Account.*—This estate which is about 173 acres in extent was purchased for Rs. 83,889/- in August, 1933, from Supplementary Votes passed for the purpose. This amount includes Rs. 80,000/- being value of the property; Rs. 1,944/- being cost of transfer expenses Rs. 425/- being the liquidator's fee for winding up the Dartonfield Estate, Company, Limited, and Rs. 1,520/- being amount paid for liquidating the forward contract to supply rubber at 15½ cents for six months in 1934, at 21 cents a pound inclusive of the broker's fee. The last item of expenditure might have been avoided but it is understood that it was incurred with a view to starting experiment work early in 1934.

22. *London Plant—Rs. 11,333/-.*—The balance at the end of 1932 was Rs. 7,967/-. The sum of Rs. 3,366/- written off on account of depreciation since August, 1930, was restored to this account and credited to the Depreciation Reserve Account.

23. *Saleable Books.*—The balance on December 31, 1932, was Rs. 4,587/-. Of this amount a sum of Rs. 2,175/- has been written off, pending the sanction of the Board, in respect of obsolete books and a sum of Rs. 65/- has been deducted as the value of books sold, leaving a balance of Rs. 2,347/-.

24. *Advances—Rs. 212/-.*—This represents the unexpired portion of the premia paid on Insurance Policies and the proportionate amounts of the telephone rents for the periods extending into 1934.

25. *Deposits.*—The sum of Rs. 35/- represents amounts paid to the Post Office at Neboda as deposits for trunk calls and phonograms.

26. *Sundry Assets at Experiment Station—Rs. 43/-.*—This represents the balance of the amount advanced for expenditure at the Experiment Station.

27. *Sundry Assets at Dartonfield Estate—Rs. 90/.*—This represents the value of rice in stock and balances of sodium, acid, blasting powder, etc., less certain debts which remained unpaid on December 31, 1933.

28. *Sundry Debtors—Rs. 19,886/-.*—Of this sum Rs. 16,003/- was due from the Deputy Financial Secretary on account of cess collections made during December, 1933. This was received from him in January, 1934. Rs. 2,066/- is the accrued interest to December 31, 1933, on Fixed Deposits which would mature during 1934. Rs. 100/- was due from the London Committee on samples of rubber sold by them and Rs. 1,716/- from Messrs. Lee, Hedges & Company as profit on the working of Dartonfield Estate from August to December, 1933.

29. *Cash Account—Rs. 239,799/-.*—Receipts for the amounts lying in Fixed Deposit were inspected, the amount in current account was verified with reference to Bank Certificate and the balance in hand was verified.

IV. *General.*

30. The accounts were received quarterly and examined in this office. The office at Neboda was visited twice and Dartonfield Estate once. The books and accounts kept at these offices were checked in detail and the cash balances verified.

I am, Sir,
Your Obedient Servant,

O. E. GOONETILLEKE,
Auditor-General.

RUBBER RESEARCH SCHEME (CEYLON).

Income and Expenditure Account for the Year ended 31st December, 1933.

DR. | CR.

	Rs. cts.	Rs. cts.
To Personal Emoluments:—		
Salaries of Technical Officers	35,715 73	
Salaries of Subordinate Staff	6,343 50	
Rent Allowance	332 00	
Provident Fund Contribution	1,522 08	
		43,913 31
Other Charges:—		
Upkeep of Laboratory	593 92	
Apparatus from London	340 09	
Samples for Imperial Institute	390 20	
Dusting Experiments	408 21	
		1,732 42
Upkeep of Buildings	793 30	
Insurance of ,,	298 76	
Upkeep of Water Supply	440 17	
Upkeep of Roads	243 82	
		1,776 05
Printing and Advertising	1,757 91	
Stationery	755 67	
Postages and Telegrams.	946 27	
Books & Periodicals	551 84	
General Charges	331 38	
Audit & Accountancy	245 94	
Telephones	410 00	
Travelling expenses of Staff	2,673 80	
Travelling expenses of Board Members	1,317 13	
		8,989 94
Share of expenditure of London Advisory Committee for Rubber Research (Ceylon & Malaya)		18,602 07
Experiment Station Upkeep Charges		134 53
Depreciation:—		
Buildings @ 5%	2,287 41	
Laboratory Apparatus @ 25%	1,234 75	
Water Supply @ 10%	187 20	
Furniture, fittings and office equipment @ 10%	705 88	
London Plant £100 @ Rs. 13-50 to the £ sterling.	1,350 00	
		5,765 24
Balance as per Balance Sheet, being excess of Income over Expenditure for the year 1933.		105,738 79
Total		186,652 35

	Rs. cts.	Rs. cts.
By Cess Collections received January to November	160,757 66	
Cess Collections due for December.	16,003 00	
		176,760 66
Interest on Fixed and Current Accounts.		7,599 05
Sale of Publications & Subscriptions		311 64
Sundry Receipts.		201 06
Sundry Receipts at Experiment Station, Nivitigalakele.		63 45
Profit from Dartonfield Estate		1,716 49
Total		186,652 35

Audited and found correct:

O. E. GOONETILLEKE.
Auditor-General

Audit Office,
Colombo, 2nd March, 1934.

W. YOUNGMAN.
Chairman, Board of Management,
Rubber Research Scheme, (Ceylon).

RUBBER RESEARCH SCHEME (CEYLON).

Balance Sheet at December 31, 1933

LIABILITIES

	Rs. cts.	Rs. cts.
Sundry Creditors		2,687 48
Reserve Fund for Bonus and Passages:—		
As per Balance Sheet, December 31, 1932.	5,955 40	
Less payments during the year	1,410 34	
		4,545 06
Provident Fund Reserve Account:—		
As per Balance Sheet, December 31, 1932.	1,827 05	
Addition during 1933.	3,660 59	
		5,487 34
Depreciation Cash Reserve Account:—		
Depreciation allowed 1930-1932.	16,243 72	
Depreciation allowed 1933.	5,765 24	
		22,008 96
Saleable Books Reserve Account:—		
As per Balance Sheet, December 31, 1932.	4,587 50	
Less value of books sold during 1933. Rs. c. 65 00		
Less value of obsolete books written off 2,175 00	2,240 00	
		2,347 50
Contribution to Capital Outlay:—		
Permanent Reserve Account transferred as per Balance Sheet, December 31, 1932.	46,550 00	
Experiment Station Reserve Account transferred as per Balance Sheet, December 31, 1932.	90,984 47	
London Plant Reserve Account transferred as per Balance Sheet, December 31, 1932.	6,483 70	
Add amount transferred from Surplus Account, being difference in value included in the Reserve account of Buildings, Laboratory Apparatus, Water Supply, Furniture & London Plant at December 31, 1932	31,778 69	
Addition in 1933.	90,079 20	
		265,876 06
Surplus Account:—		
Balance of Income and Expenditure as per Balance Sheet, December 31, 1932.	241,455 23	
Less amount transferred to 'Contribution to Capital Outlay Account' being difference in value, included in the Reserve Accounts of Buildings, Laboratory Apparatus, Water Supply, Furniture & London Plant	31,778 69	
	209,676 54	
Add excess of Income over expenditure for the year 1933. Rs. c. 105,738 79		
Less amount transferred to Contribution to Capital Outlay Account 90,079 20		
	15,659 59	
		225,336 13
Total		528,288 83

ASSETS

	Rs. cts.	Rs. cts.
Buildings Account:—		
As per Balance Sheet, December 31, 1932.	45,748 14	
Add Depreciation allowed 1930-1932.	7,225 35	
Add purchases during the year	66 50	
		53,039 99
Laboratory Apparatus Account:—		
As per Balance Sheet, December 31, 1932	4,938 99	
Add Depreciation allowed 1930-1932.	3,263 85	
Add Purchases during the year	749 50	
		8,952 34
Water Supply:—		
As per Balance Sheet, December 31, 1932.	1,872 02	
Add Depreciation allowed 1930-1932.	532 30	
		2,404 32
Furniture, Fittings & Office Equipment:—		
As per Balance Sheet, December 31, 1932.	7,058 78	
Add Depreciation allowed 1930-1932.	1,855 55	
Add Purchases during the year.	217 50	
		9,131 83
Development of Experiment Station, Nivitigalakele:—		
As per Balance Sheet, December 31, 1932.	90,984 47	
Add land acquisition account transferred	984 07	
Add expenditure during the year.	4,908 34	
		96,876 88
Dartonfield Estate:—		
Cost of purchase and preliminary expenses	83,888 92	
Add expenditure on Agricultural Development during the year.	248 44	
		84,137 36
London Plant Account:—		
As per Balance Sheet, December 31, 1932.	7,966 67	
Add Depreciation allowed 1930-1932.	3,366 67	
		11,333 34
Stock Account of Saleable Books:—		
As per Balance Sheet, December 31, 1932.	4,587 50	
Less value of books sold during 1933. Rs. c. 65 00		
Less value of obsolete books written off. 2,175 00	2,240 00	
		2,347 50
Payments in Advance:—		
Insurance and Telephone rent.		211 79
Deposits:—		
As per Balance Sheet, December 31, 1932.	30 00	
Additional deposit on phonograms in 1933.	5 00	
		35 00
Sundry Assets at Experiment Station, Nivitigalakele:—		
Cash in hand		43 25
Sundry Assets at Dartonfield Estate:—		
Stores in hand		90 20
Sundry Debtors:—		
Cess Collection for December and arrears	16,003 00	
Interest accrued on Fixed Deposit	2,066 02	
Sale of Rubber by London Committee	100 26	
Profit from Dartonfield Estate	1,716 49	
		19,885 77
Cash:—		
In Fixed Deposit at National Bank, Colombo	60,000 00	
In Fixed Deposit at Mercantile Bank, Colombo	45,000 00	
In Fixed Deposit at Imperial Bank, Colombo	40,000 00	
In Fixed Deposit at Chartered Bank, Colombo	30,000 00	
In Fixed Deposit at Hongkong & Shanghai Bank, Colombo	30,000 00	
In Current Account at National Bank, Colombo	34,680 32	
In Hand	118 94	
		239,799 26
Total		528,288 83

I hereby certify that the accounts of the Rubber Research Scheme for the year 1933 have been audited and that in my opinion the above Balance Sheet correctly sets forth the position of affairs as shown by the books at December 31, 1933.

O. E. GOONETILLEKE,
Auditor-General.

W. YOUNGMAN,
Chairman, Board of Management, Rubber Research Scheme, (Ceylon).

Colombo, 2nd March, 1934.

ESTIMATES FOR 1934.

(Adopted by the Board, November 23, 1933).

REVENUE STATEMENT.

Income for 1934.	Rs. cts.
1. Cess Collections	140,000 00
2. Interest	3,750 00
3. Sale of Publications	300 00
4. Profit from Dartonfield Estate	3,680 00
5 Sundry Receipts	100,00
Total Rs.	147,830 00

EXPENDITURE STATEMENT.

		Rs. cts.	Rs. cts.
1.	**Personal Emoluments:—**		
	Salaries and Wages ...	56,071 00	
			56,071 00
2.	**Laboratory:—**		
	(*a*) Upkeep, Chemicals and Apparatus	5,000 00	
	(*b*) Samples for London experiments	500 00	
	(*c*) Dusting experiments ...	600 00	
	(*d*) Routine tests on Chemicals ...	100 00	
			6,200 00
3.	**Buildings:—**		
	(*a*) Upkeep of Buildings ...	1,000 00	
	(*b*) Insurance	105 00	
	(*c*) Upkeep of Water Supply ...	600 00	
	(*d*) Upkeep of Roads	200 00	
	(*e*) Furniture Replacements ...	200 00	
			2,105 00
4.	**Office:—**		
	(*a*) Printing and Advertising ..	1,750 00	
	(*b*) Stationery	1,000 00	
	(*c*) Postages	1,000 00	
	(*d*) Books and Periodicals ...	500 00	
	(*e*) General Charges ...	500 00	
	(*f*) Audit and Accountancy ...	400 00	
	(*g*) Telephones	620 00	
			5,770 00
5.	**Travelling:—**		
	(*a*) Travelling expenses of Staff ...	4,500 00	
	(b) Travelling expenses of members of the Board of Management. ...	1,750 00	
			6,250 00
6.	**Experiment Station (Nivitigalakele):—**		
	Development and Upkeep ...	5,225 00	
			5,225 00
		Carried over	Rs. 81,621 00

EXPENDITURE STATEMENT.—*Contd.*

		Rs. cts.	Rs. cts.
	Brought forward		81,621 00
7.	**Special Charges:—**		
	London Advisory Committee's expenditure (½ share) ...	18,900 00	
			18,900 00
8.	**Passage Fund Reserve:—** ...	1,250 00	
			1,250 00
9.	**Passages to Ceylon:—** ...	1,815 00	
			1,815 00
10.	**Depreciation Account:—** ...	5,765 00	
			5,765 00
11.	**Dartonfield Estate:—**		
	Expenditure on experiments ...	5,611 00	
			5,611 00
12.	Special items of Expenditure on **Capital Account:**		
	Dartonfield Estate:—		
	(*a*) Erection and Equipment of Factory and Laboratory. ...	50,000 00	
	(*b*) Scientific Apparatus ...	5,000 00	
	(*c*) Superintendent's bungalow ...	7,500 00	
	(*d*) 4 Sub.-staff bungalows ...	8,000 00	
	(*e*) Replanting 7 acres of rubber .	1,400 00	
	(*f*) Extension and improvement of cart road.	3,000 00	
	(*g*) Fencing estate	3,000 00	
	(*h*) Survey of estate	400 00	
			78,300 00
	Total Rs. ...		193,262 00

Summary:—

Estimated total income	147,830 00
Estimated expenditure during 1934 ...	193,262 00
Excess of Expenditure over Income during 1934.	45,432 00